iPOLE
THE FUTURE OF USER MANUALS

ALSTOM

MEET TEAM SPOCK

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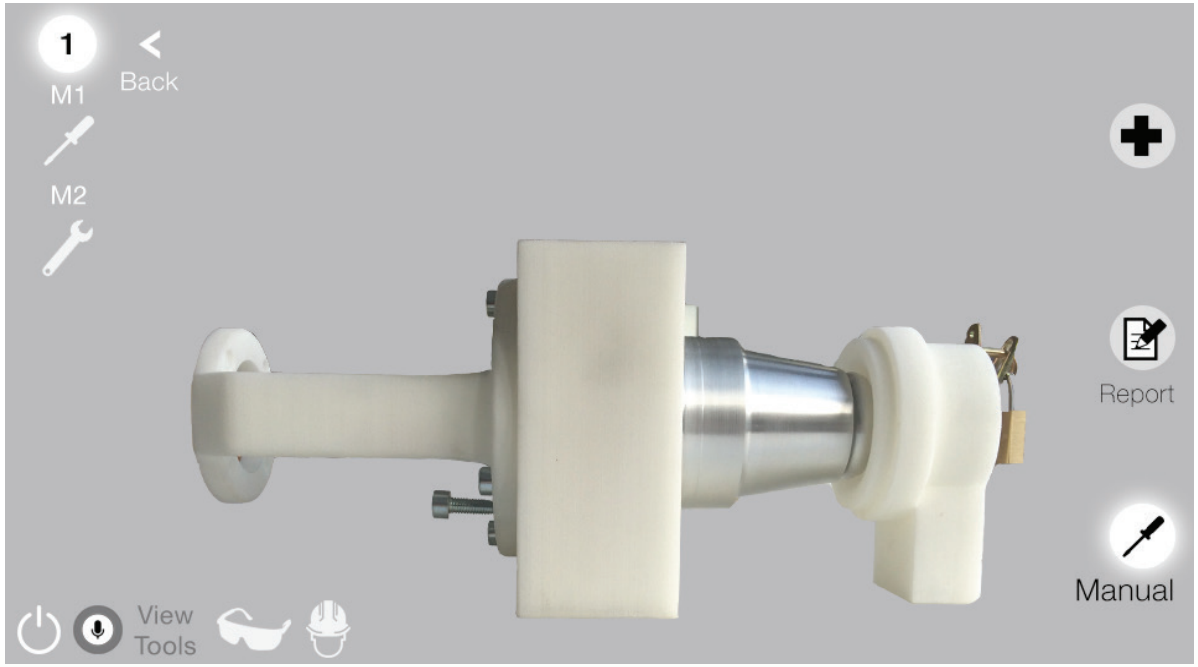
CONTENTS

Executive Summary	5
1 Briefing Week	**6**
1.1.0 Team Roles	7
1.1.1 Project Plan	8
1.1.2 Idea Generation	9
1.1.3 Initial Ideas	10
1.1.4 Vision	11
2 Research	**12**
2.1.0 Alstom	13
2.1.1 Competitors	14 - 15
2.1.2 Health And Safety	16 - 17
2.1.3 Reporting Systems	18
2.1.4 Speech Control	19
2.1.5 Gesture Control	20 - 21
2.1.6 Education Theory	22 - 24
2.1.7 Technology	25
2.1.8 User Interfaces	26
3 User Research	**27**
3.1.0 Job Description	28 - 30
3.1.1 Personas	31 - 32
3.1.2 Customer Journey Map	33
3.1.3 Workflow	34
3.1.4 Workflow Development	35
3.1.5 Stakeholder Analysis	36
3.1.6 Task Analysis	37 - 38
4 Technology Development (Prototype)	**39**
4.1.0 Lego task	40
4.1.2 Prototype development	41
5 2016 Development	**42**
5.1.0 Idea Development	43

CONTENTS

5.1.1 Initial Designs	44
5.1.2 Design Development	45
5.1.3 System Architecture	46
5.1.4 Low-Fidelity Wireframes	47
5.1.5 Mid-Fidelity Wireframes	48
5.1.6 Mockups	49
5.1.7 Interface Development	50 - 51
5.1.8 Interface Concept	52 - 54
5.1.9 User Testing	55
5.2.0 Final Designs	56 - 61
6 2024 Development	**62**
6.1.0 Storyboard	63 - 64
6.1.1 Filming	65
6.1.2 Video development	66 - 71
7 Conclusion	**72**
7.1.0 Project Results	73
7.1.1 Team Conclusion	74
Bibliography	**75**

EXECUTIVE SUMMARY



During iPOLE project 2014 we are confronted with new technology planned to use in a dangerous environment. We wanted to give emphasis to these two facts and included them in our vision:

‘Improve work efficiency by hands-free interaction while keeping workers safe.’

Our vision explained further:

Hands-free interaction
For the first time in history of manuals, workers don’t have to use their hands to get information out of a manual. This enables them to use their hands for the «real» work anytime, they don’t have to switch from using tools to using the manual and back. This leads to higher work efficiency while working at an ALSTOM power plant.

Keeping workers safe
Using glasses and therefor having information displayed right into your natural view will definitely need some learning and adjustment time for ALSTOM employees. Nobody can expect a worker to work productively while using the glasses for the first time. Even later, the glasses will often distract workers since they cannot pay attention to the real world environment all the time. For ALSTOM, it will be very important to keep this fact in mind while developing new application concepts for the glasses. We think, ALSTOM should implement the health and safety aspect as an additional feature, it should be an integral part of a glass operating system or a glass application.

Development of design
On a glasses user interface it is important to place permanent icons not in the center of the view, where it could distract the natural view of the workers. At the same time temporary and very important information should be placed in the center, otherwise chances are high a worker misses the information.
For our final user interfaces, we decided to put status icos to the borders and let important notifications to show up in the center as text.

1. BRIEFING WEEK

TEAM ROLES

MATTHIAS GIGER

- Research
- Programming
- Lego Task
- Filming

FABIAN KÜNZLI

- Research
- Programming
- Management
- Filming

JULIA EPPLER

- Research
- Filming
- 2024 development

AARON CHATHA

- Research
- UI/UX
- Design Document
- 2016 development
- 2024 development

FABIAN GLIGOR

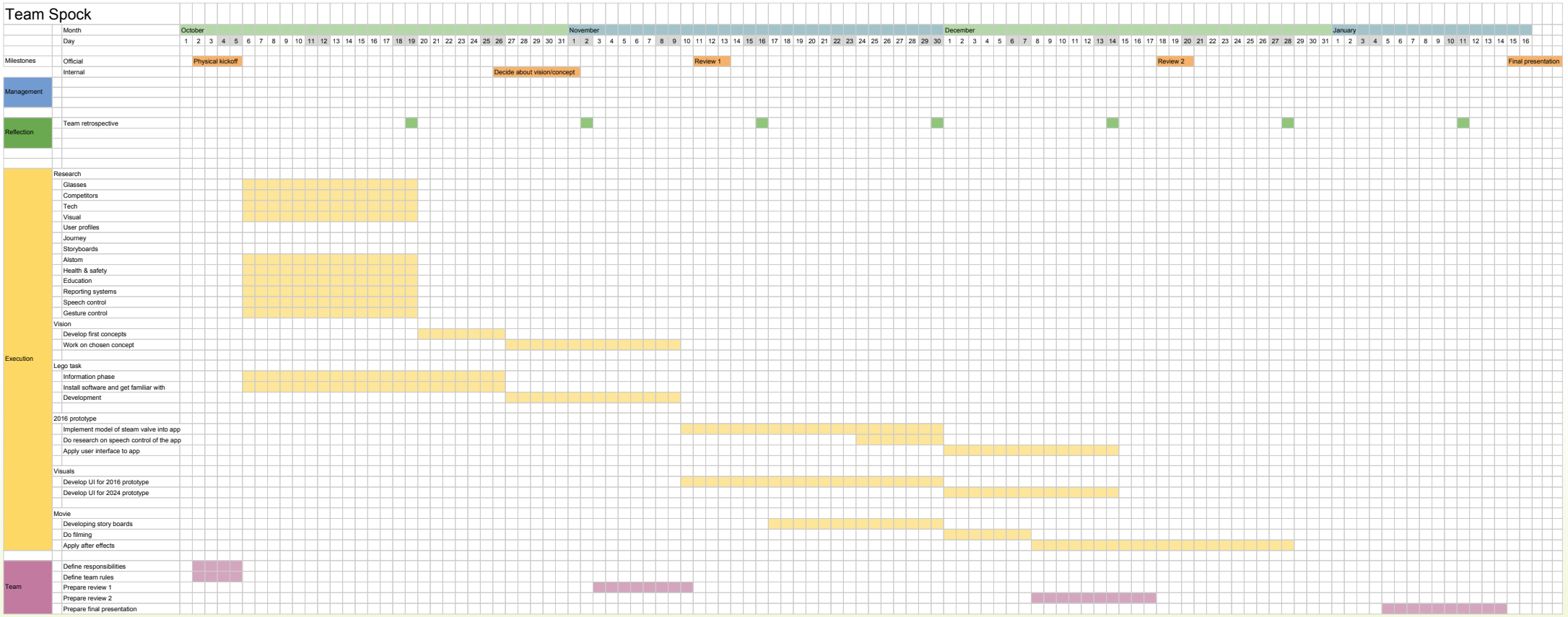
- Research
- Filming
- 2024 development

SOPHIE TYLER

- Research
- UI/UX
- Video Editing
- 2016 development
- 2024 development

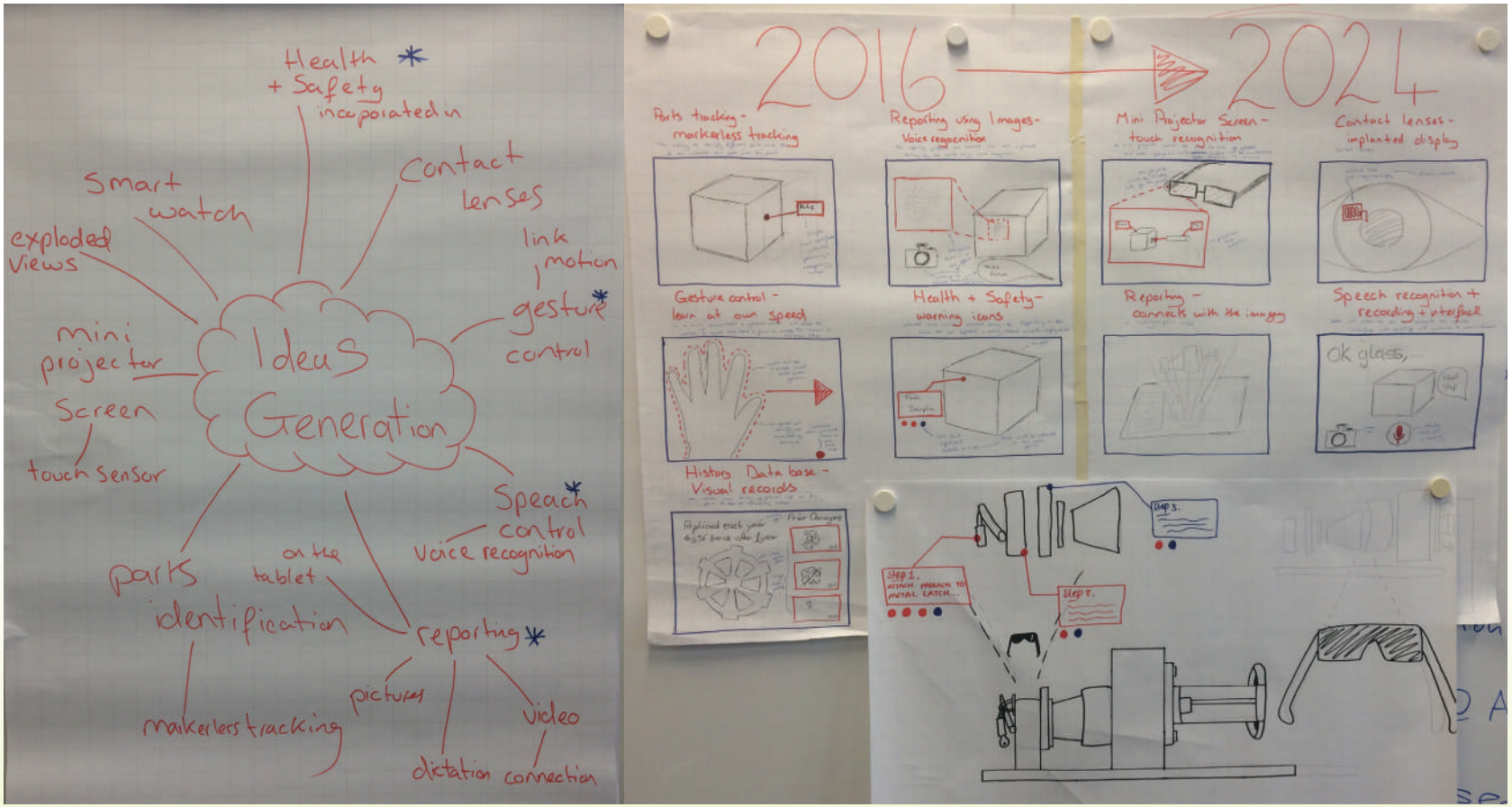
We wanted to enable people to focus on their part, so that they don't have to think about every aspect of the iPOLE project. Therefor we shared our strenghts and weaknesses and decided about the project roles shown above.

PROJECT PLAN



We wanted to have an overview of the whole project. It helps us to take decisions and to better focus on the current project phase. The main tasks were to develop a vision for 2024, which automatically had an impact on the 2016 prototype. Based on this vision, we developed the user interface and created a movie, which shows the 2024 vision.

IDEA GENERATION



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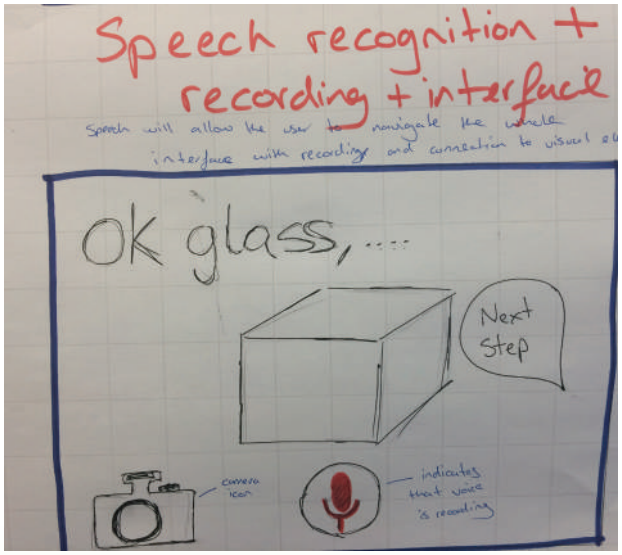
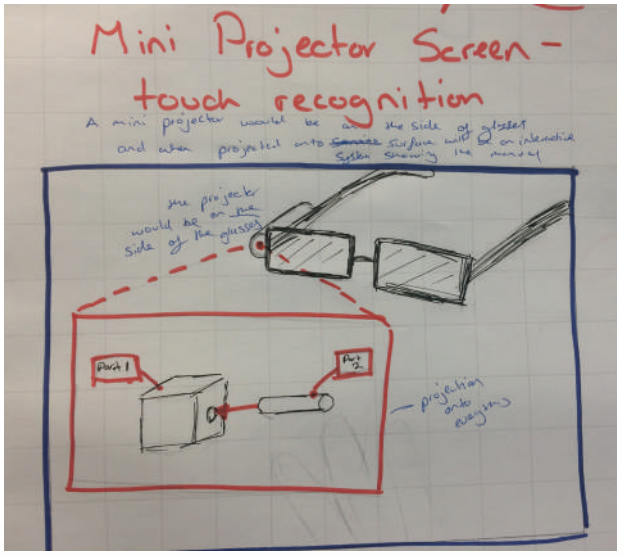
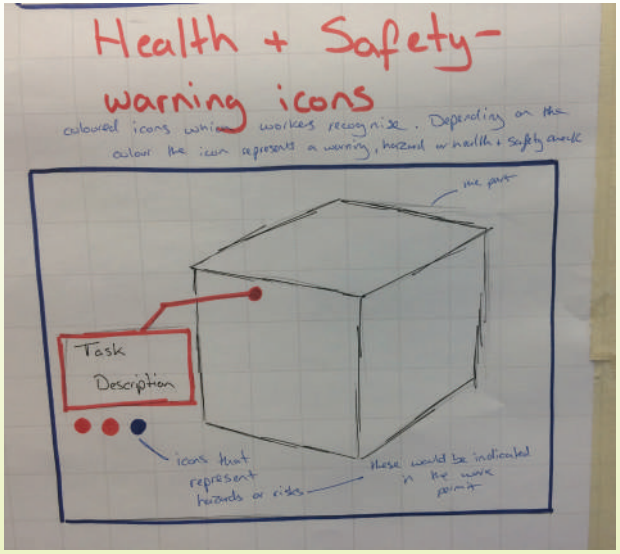
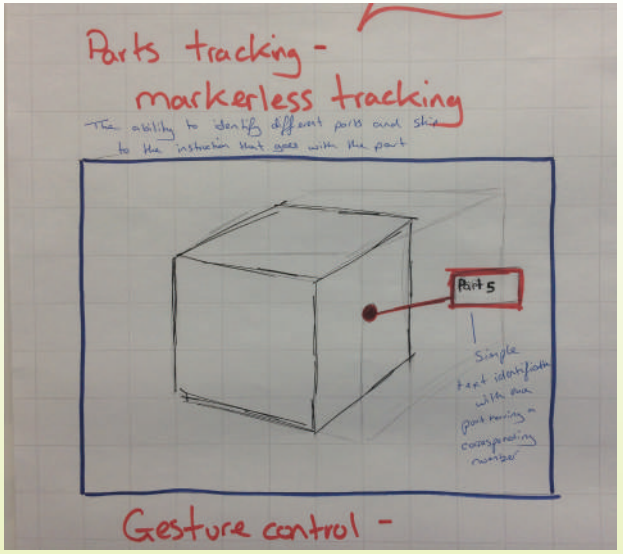
INITIAL IDEAS

During the kick-off days we had the possibility to work closely together and do some brainstorming about what the focus of our project will be. As seen on the right picture, we chose Health + Safety, Gesture control, Speech control and reporting as our main ideas we want to work on.
We already sketched our first ideas which show these aspects. The most important sketches will follow on the next page in detail.









VISION

“Improve work efficiency with hands-free interaction, while keeping workers safe.”

2. RESEARCH

ALSTOM

Alstom is an extensive company, which stretches across the world with bases in Europe, Asia, the Middle East, Australia, Africa and North and South America. Alstom boasts over 130 years experience in the electrical transmission sector and a portfolio of power equipment and software solutions.

Services that Alstom offer include electrical infrastructure, increase return on investment and increases the lifecycle of existing electrical grids. Within the field 1000 Alstom employees work with customers providing expertise service within the network.

Alstom has a long history, which started in 1928 and goes all the way to today. Alstom over the years has merged with several companies changing throughout time in name and purpose until finally in 1998 Alstom emerges as what we know today. The founding of Alsthom (the first variation of the name) was in 1928 by the merger of Societe Alsacienne de Constructions Mecaniques and Thomson-Houston. From that point on there is a timeline of events that lead up to what we know as Alstom today with multiple company mergers including the UKS General Electric Company (GEC) and Frances Compagnie Generale d'Electricite (CGE). These company mergers and investment gave Alstom the ability to grow and spread across the globe.

Alstom while an old well established company is by no means stuck in the past though with their electrical networks evolving into a smart grid. Smart grids are an intellectual electrical networks with two-way flow of energy giving real-time information between power generations. The new technology as well allows better integration of renewable energies and more efficient electrical transmission across the whole energy grid.

COMPETITORS

Competitor research entails the analysis of how competing companies to Alstom are working to fix the problem of the user manual. Other aspects of the research include looking at all smart glasses that are available and comparing them to the Epson smart glasses which we are using for the project.

Competing Companies:

Alstom is an extensive worldwide company, which has many branches of business including power and transport. For power competitors the top 10 which Alstom has to compete with are…

- EDF, France
- Enel, Italy
- E.ON, Germany
- Iberdrola, Spain
- Duke Energy, USA
- Exelon, USA
- Southern Company, USA
- Next Era Energy, USA
- Dominion Resources, USA
- SSE, UK

These competitors are all high-end power companies who give great service to their customers and employers. So far though many are still using the old user manual system, which gives Alstom an advantage that is using this project to help develop a new user manual system.

Smart Glasses:

The Epson glasses we are working with are the second-gen Moverio BT-200 glasses and are one of the few smart glasses available to the public in 2014. When searching for information on the glasses a competitor system developed for the glasses came to light. The idea was a prototype showing a 3d projection mapped onto a mechanical device. The 3d projection gave the user a chance to see an augmented reality image, which showed them exactly what to do.

When it comes to competitors in tech Google glass is one of the biggest. Google glass started to be developed back in 2012 and was available by 2013 but mainly for use within Google. Google glass and smart glasses in general had already hit the headlines with worries on privacy and safety, an example of the extent of worry on safety is when West Virginia became the first state to draw up a nil banning the use of wearable tech glasses while driving. In April 16th 2013 though Google glass officially became available to the public. Scott Torberg and Star Simpson did a Google glass teardown and an overall observation is that “Its surprisingly simple”. To evaluate Google Glass Torberg and Simpson looked at what the product contains, the hardware, the case, the side touchpad, the behind ear module, speaker, display, optics and camera. When receiving Google glass the box only contains a few accessories, which are, tinted shield, clear shield, charger/AC adaptor, USB cable and drawstring soft case these accessories like the product are of a very high build quality with a solid feel and a good surface finish. Torberg and Simpson then took to dissecting Google

COMPETITORS

Glass and found with great surprise while it is the next technical jump it is simpler then led to believe.
Other smart glasses to compete with the Epson glasses we are working with are few and far between with companies only recently finishing the development of there new smart glasses meaning there possibilities are not fully known. Newly developed smart glasses that we know of include…

• **EmoPulse nanoGlass-4**
The nanoGlass-4 glasses are connected to your smartphone using Bluetooth. The glasses show a colour signal, which tells the user about short messages, incoming calls and other events on their phone. The simple use of lights is inventive but not innovative with no direct screen on the actual lenses.
• **Glass Up AR Smart Glasses**
GlassUps main aim is not to use as a novelty to play videos but to give driving directions, notifications and emails for example. Glass Up as well concentrates on the design of the glasses in making them look like a normal glasses with the best frames for comfort as well as style. GlassUp is mainly an application use for keeping an eye on social media updates and possible use as AR map for directions.
• **ION Smart Glasses**
ION glasses have functions such as to provide notifications, remote controls, alerts and customization. The glasses are integrated with Bluetooth and a multi-colour LED display the main appeal of ION glasses is its features are discretely hidden making them seem like ordinary glasses.
• **Meta AR Smart Glasses**
The META AR smart glasses are said to be the closest you can get to being the real life Tony Stark. They accomplish this with functions including £D see through display, camera, head tracking and audio. Meta so far though is still only available exclusively for 'META pioneers', which you have to apply to, to gain the product.
• **Pivothead Smart Glasses**
A camera, which takes pictures and records, is the main and only function for Pivothead smart glasses. While the camera is very hidden making a sleek design for the glasses the limitation on function makes it not very desirable.
• **Vuzix M100 Glasses**
The Vuzix M100 glasses offer the digital world hands free with access to information, data collection and more. The Vuzix like Epson is an android-based device with display camera and wireless connectivity.

When comparing other smart glasses against the Epson Moverio BT-200 glasses many do not match up with only minor functions or only for one use. Apart from Google glass the only other smart glasses, which are similar and could potentially be used for commercial use are the Vuzix M100 glasses which has virtually all the same functions that Epson glasses provide.

HEALTH AND SAFETY

Due to the fact Alstom is a global leading company, providing energy and transport, it is vital they take health and safety into consideration and provide clear policies as to what they except. Alstom offer their employees the best safety and working conditions and have a commitment to give all Alstom employees and all people working under Alstom's responsibility the best and safest working conditions everywhere in the world. This is a keystone of their CSR policy in the way they operate.

A network of 800 managers and experts are responsible for ensuring that Alstom's health and safety policy is communicated, understood, implemented and maintained throughout the Group.
A single and stringent approach to safety for the entire Group has been developed to focus on high-risk activities and protect all Alstom employees and contractors worldwide from the risks they may face when working for Alstom. This approach is the Alstom Zero Deviation Plan (AZDP), launched in November 2011, which is made up of three priority actions:

Action 1: The in-depth analysis of severe accidents and follow-up of corrective actions.
Action 2: The implementation and audit of Alstom Safety Directives covering high-risk activities.
Action 3: A stronger control of contractors through a clear set of EHS requirements.

Development of safety culture
Alstom emphasises the development of a safety mindset for every employee with a specific attention paid to managers who must be proactive in safety and lead by example. This strategy is supported by a strong EHS training ambition with several safety training modules dedicated to managers, employees and EHS specialists. Around 3,000 employees are trained each year in classrooms and over 30,000 using e-learning EHS modules. In addition, every Alstom line manager whose action is influencing EHS performance of the Company has a part of his bonus scheme linked to the Sector EHS performance.

The safety and wellbeing of Alstom employees, those working alongside Alstom employees, and visitors to an Alstom-owned or operated site, is one of their highest priorities. In the UK, Alstom has stringent Environment, Health and Safety policies and management systems, which have enabled them to achieve a strong safety record across the industries in which they operate. Commited to provide a safe work environment for employees and sub-contractors, the breadth of our commitment is demonstrated in our Environment, Health and Safety (EHS) policy deployed through our EHS management system, alongside more specific programmes designed to ensure health and safety for our employees across the globe.
Alstom commits to maintaining and developing a proactive Environment, Health and Safety culture throughout the Group. Each Alstom entity is responsible for implementing programmes and training to achieve best practice for EHS protection.

A. All personnel working on site

1. E-learning (90 min.) High Risk Activities (HRA) no requirement for repetition.
E-learning for increased awareness regarding High Risk Activities.
As part of Alstom's objective Zero serious accidents, all individuals who work for Alstom on sites and in workshops, must from November 1, 2013, and onwards have performed Alstom's e-training High Risk Activities

HEALTH AND SAFETY

(HRA) prior start of work at site.
2. Alstom's annual safety training (2 h), Alstom provide this training. Yearly repetition. Contact Alstom employer for information and planning.
3. On every site the Contractor's personnel shall take part in the site-specific induction.

B. Personnel that shall perform or supervise high-risk activities

Following High Risk Activities requires advanced training prior start of work:
(Repetition every five (5) year if nothing else is specified)
High Risk Activity
Work with fire hazard
Work with radiation hazard
Work requiring isolation/lock-out tag-out, e.g. electrical work, work in confined spaces, machine safety
Working at height
Lifting operations and lifting equipment
Electrical work
Truck, fork lift drivers
Working with hydraulic equipment

Health and Safety- Epson glasses
The latest developments in wearable technology, such as smart glasses, have the potential to immensely improve worker efficiency in field service, maintenance and manufacturing. Smart glasses will help field service technicians diagnose and fix problems faster, without needing to bring additional experts to remote sites. Through augmented reality and head-mounted cameras, smart glasses will give these professionals access to real-time information and deep expertise, making them more effective at, say, maintaining or assembling a piece of equipment.

Although these glasses have the ability to improve worker efficiency they also come with some health and safety issues. Wearing heads-up displays such as the Epson glasses can contribute to eye fatigue and may cause visual confusion, according to ophthalmologist and entrepreneur Sina Fateh, who has filed more than 30 patents related to heads-up displays. "The problem is that you have two eyes and the brain hates seeing one image in front of one eye and nothing in front of the other,". Heads-up displays can cause such problems as binocular rivalry, visual interference and a latent misalignment of the eyes that results when both eyes don't look at the same object.

Due to the potentially dangerous machinery employees at Alstom will be working with, the Epson glasses may prevent workers from paying their full attention to the machines and cause serious injury. This needs to be taken into account when it comes to the design stage and the interface of the glasses shouldn't be too distracting.

REPORTING SYSTEMS

Permit to work process

Work order
(Define the work scope and methods)
General safety risk assessment
(Identify the risks and define the control measures)
Application work
(For system safety risk consideration)
System safety risk assessment (SSRA)
(Identify the system hazards and define the control measures)
Isolate the system and issue
(System hazards controlled and the safety document (base on SSRA result) equipment released for work)
Carry out the work
(Execute the work with general safety measures)
Clearance on complete

• Actions and control: CSMS software
• Alstom user manual contents…
-Labeling of main parts
-Tool preparation
-Lock out/tag-out
-Dis-assembly
-Inspection
-Re-assembly

Reporting needs to cover…

-Operating data for the part
-Measurements need to be logged
-Pictures to show the condition
-Assessment of the parts for further use
-What needs to be replaced on the condition and what are the replacement parts (identified)
-Are there things that need to be repaired?
-Test results
-Work improvements/process improvements noted while executing the work
-Safety at work
-New ideas to make work easier/safer

A good reporting system in industry is vital and Alstom have a set of guidelines they follow, if they were to report an incident or a faulty machine for example. Currently, Alstom don't have a very good digital reporting system and a well-designed system could be very beneficial to them, due to the time they could save when reporting a fault.

SPEECH CONTROL

Speech Control (or voice control) is already part of our lives in different appearances. For example Siri is available for everybody in the iPhone 4s since 2011. You can talk with Siri, ask for information and dictate messages. Today you can also find a similar system in cars or even in houses.

Nuance could also be known. It is the worldwide leading provider of speech recognition an “Natural Language Understanding (NLU). The company introduced the voice-controlled assistant Siri in form of a stand- alone app in the iTunes store - before Apple took it over and marketed as an integral of the iPhone 4s. Nuance is working on different inventions in automobile, TV and Tablets. Also they are working on the input method “ Swype “ to supplement the learning function . New words which are “teached” to the keyboard are synchronized with the cloud and can be used by multiple devices at the same time.

But you can also find many problems in voice control. Vocalizations vary in terms of accent,pronunciation, articulation, roughness, nasality, pitch, volume, and speed. Speech is distorted by a background noise and echoes, electrical characteristics. Accuracy of speech recognition vary with the following

- Vocabulary size and confusability
- Speaker dependence vs. independence
- Isolated, discontinuous, or continuous speech
- Task and language constraints
- Read vs. spontaneous speech
- Adverse conditions

GESTURE CONTROL

Gesture Control is already in our lives. Beside Touch-screens and Speech Control, Gesture Control is also part of things such as video games (Xbox Kinect).

Gesture recognition enables humans to communicate with the machine and interact naturally without any mechanical devices. Using the concept of gesture recognition, it is possible to point a finger at the computer screen so that the cursor will move accordingly. This could potentially make conventional input devices such as mouse, keyboards and even touch-screens redundant

The ability to track a person's movements and determine what gestures they may be performing can be achieved through various tools. Although there is a large amount of research done in image/video based gesture recognition, there is some variation within the tools and environments used between implementations.

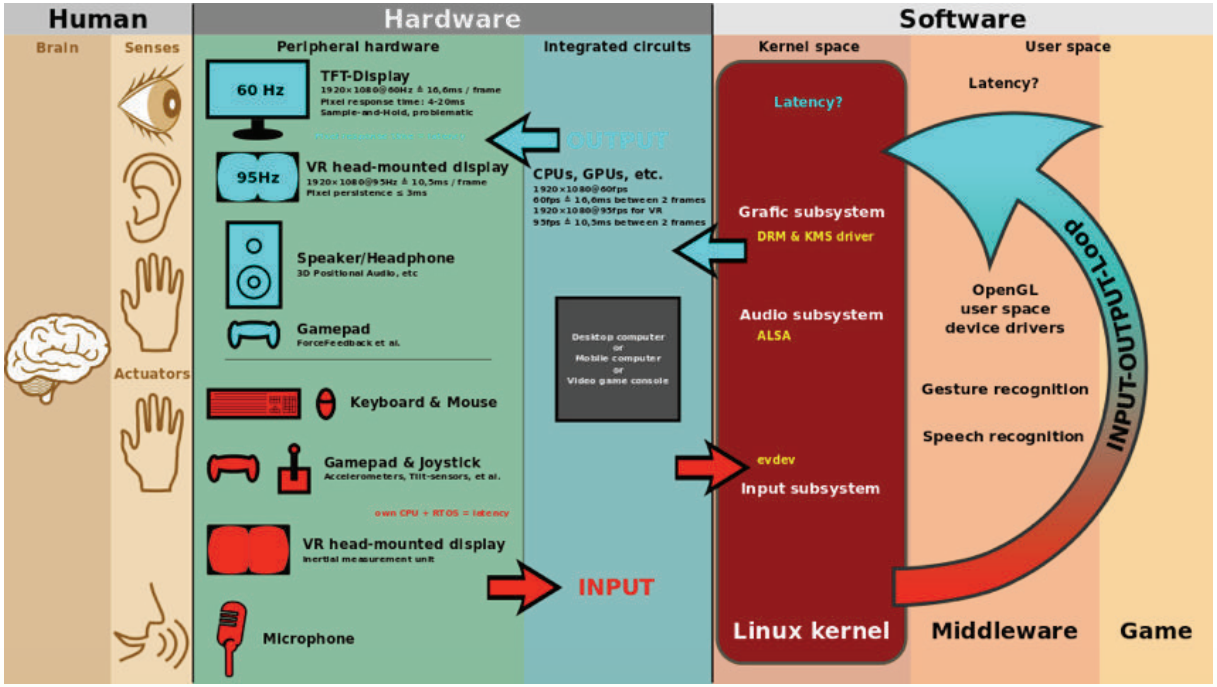
• Wired gloves. These can provide input to the computer about the position and rotation of the hands using magnetic or inertial tracking devices. Furthermore, some gloves can detect finger bending with a high degree of accuracy (5-10 degrees), or even provide haptic feedback to the user, which is a simulation of the sense of touch. The first commercially available hand-tracking glove-type device was the DataGloves a glove-type device which could detect hand position, movement and finger bending. This uses fiber optic cables running down the back of the hand. Light pulses are created and when the fingers are bent, light leaks through small cracks and the loss is registered, giving an approximation of the hand pose.

• Depth-aware cameras. Using specialized cameras such as structured light or time-of-flight cameras, one can generate a depth map of what is being seen through the camera at a short range, and use this data to approximate a 3d representation of what is being seen. These can be effective for detection of hand gestures due to their short range capabilities.

• Stereo cameras. Using two cameras whose relations to one another are known, a 3d representation can be approximated by the output of the cameras. To get the cameras' relations, one can use a positioning reference such as a lexian-stripe or infrared emitters. In combination with direct motion measurement (6D-Vision) gestures can directly be detected.

• Controller-based gestures. These controllers act as an extension of the body so that when gestures are performed, some of their motion can be conveniently captured by software. Mouse gestures are one such example, where the motion of the mouse is correlated to a symbol being drawn by a person's hand, as is the Wii Remote or the Myo, which can study changes in acceleration over time to represent gestures. Devices such as the LG Electronics Magic Wand, the Loop and the Scoop use Hillcrest Labs' Freespace technology, which uses MEMS acceler-

GESTURE CONTROL



ometers, gyroscopes and other sensors to translate gestures into cursor movement. The software also compensates for human tremor and inadvertent movement. AudioCubes are another example. The sensors of these smart light emitting cubes can be used to sense hands and fingers as well as other objects nearby, and can be used to process data. Most applications are in music and sound synthesis, but can be applied to other fields.

• Single camera. A standard 2D camera can be used for gesture recognition where the resources/environment would not be convenient for other forms of image-based recognition. Earlier it was thought that single camera may not be as effective as stereo or depth aware cameras, but some companies are challenging this theory. Software-based gesture recognition technology using a standard 2D camera that can detect robust hand gestures, hand signs, as well as track hands or fingertip at high accuracy has already been embedded in Lenovo's Yoga ultrabooks, Pantech's Vega LTE smartphones, Hisense's Smart TV models, among other devices.

For our manual glass also could be interesting:
https://developers.google.com/glass/develop/gdk/voice?hl=de (google glass)
http://www.gdkdemo.com/

EDUCATION THEORY

When starting the research for this project we realised that an important part we have to focus on is the people and specifically how these people learn. When researching how people learn though we decided t narrow it down to training in the workplace, which is the setting, our product would be used in. As well we will research into what other training system are in place in the workplace and what tech they are using.

Current Alstom Training

The first place we went was the Alstom websites where we found information on the type of training Alstom provides to its employees and the key resources they use. All Alstom employees are introduced on arrival to the Integrity Programme, which is linked to the ethics, and compliance training that is carried out. Face to face training sessions help to deliver knowledge and appropriate conduct to the employees. Great care is taken in this area for employees who are potentially exposed to difficult professional situations. A focus on ethics is another training module Alstom focuses on.

Resources that might help Alstom employees in there training are found in different places. The code of ethics Alstom uses for example is found on their internet-based e-learning programs.

Alstom has a well-established technical training within factories as well to help train new employees. The technical training available includes e-learning, modular training, competence development training and software training. Alstom offers 60 on-line e-learning modules, which gives current and potential employees all over the world a chance to optimize their time and money to train and learn in a field they choose.

Alstom's technical institute also provides a focused learning area with skilled employees who know the workplace and understand the latest regulations and safety rules. The Alstom technical training institute covers the entire scope of electrical substation and network needs. The grid includes power transformers, instrument transformers, circuit breakers, gas insulated substations, disconnections, protection and control systems, network management solutions, telecommunications and electrical safety.

Standardized and proven technical content and training on real equipment led by field-experienced trainers is some of the scope that is covered in the modular training that Alstom provides. The different modules that are provided give a strong pressure on hands on experience in the workplace. Software training as well is another part of the modules; this training is done during system development, integration and ramp-up. The training with Alstom also covers there network management, energy management and telecommunication solutions.

EDUCATION THEORY

A final part of training that is given to Alstom employees is competence development training. The training mainly covers a complete analysis and evaluation of competences before and after training, customized curriculum and content to meet your specifications and fast-track experience development. The program is specifically tailored to help give support and that is needed to maintain installation in optimum operating condition.

The way Alstom trains and educates there employees is an established system. This system is spread across the world and is being used in many of there technical institutes which are in several countries including the UK, USA, Canada, Australia, Brazil and more.

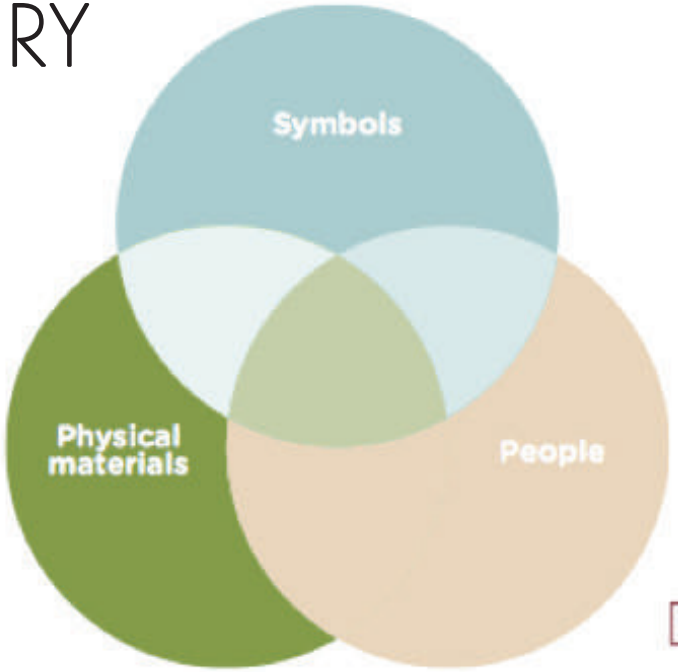
Vocational Training and Pedagogy
Vocational and pedagogy is a method of teaching using an academic or theoretical concept. Regarding education in the workplace there are several areas that can be focused on including hardware how is the equipment to be operated and used, technical what software is available and how does it work with other systems, regulations what standards does the company set in place for conduct and health and safety what rules and warnings are in place to protect employees.

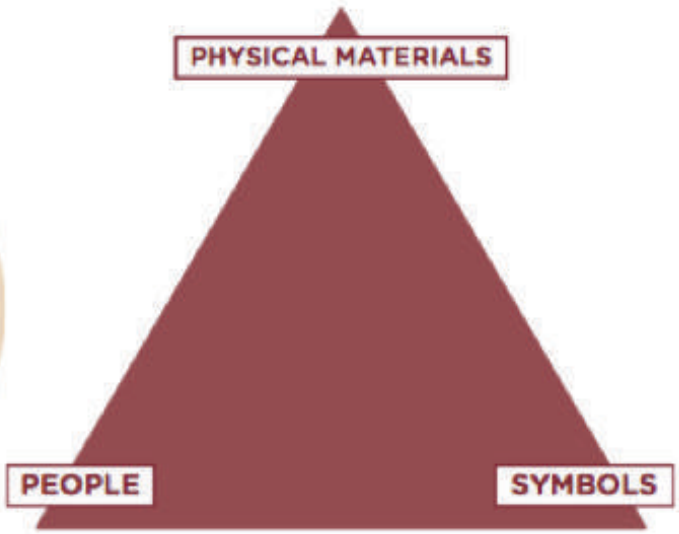
As well when thinking about training and education the level of understanding the students have as well is another factor that must be taken into education. A main point is that all the workers are adults and will have set in place ways of how they like to learn and the best way to learn for themselves.

A new thing in education is the teaching of competencies that are required in a particular role. The teaching of competence helps avoid the fragmenting and isolating of behaviours, which must be seen in interaction with one another for the performance to make sense. One study into adult learning showed that readiness to learn is a product of an adult confronting the need to know something or do something in order to perform a task. This idea of adult learning applies to our project with Alstom because unlike educating children adults have a different mind set and is more willing to see the steps they have to perform in order to complete a task.

Vocational education varies greatly from academic education of is spread widely over several. This makes vocational education is a very complicated theory. A way to make sense of vocational education in terms of groups is to categories the vocation in terms of level of skill and qualification, such as: professional, technician, craftman, skilled and semi-skilled. There is also an idea that vocational education works with three media of physical material, people and symbols (words, numbers and images). The diagrams below show visually how wherever a vocation is placed each media is always involved.

EDUCATION THEORY





Methods of vocational education include simulation, enquiry, and demonstration. Simulation is where teachers choose a scenario for students to work with. This method is an alternative to direct information so that students get real life experience. Enquiry training helps students to collect information, build concepts and test hypotheses. A method of giving a specific learning objective to help collect information, this method helps focus the students mind. A final example of a method of vocational education is demonstration that has the added dimension of an explanation by example; this is often accompanied by verbal explanation. Demonstrations of tasks are done with a related activity for students. These tasks can be completed with a variety of technological aids.

Using vocational education methods in Alstom will help the employee develop a working competence. A working competence is different from a competency and skills. The employee would have practical expertise in the task and not simply a checklist of smaller tasks. This working competence would set a standard for all tasks as well and would ensure quality throughout.
When completing are project then we will have to put much thought into how our user manual teaches the employee and whether or not vocational and pedagogy methods can be applied and how.

Training and Tech
Technology in the workplace is not unusual with technology business have been able to communicate more easily with email, human capital is helped by a quick way of recruiting and hiring candidates as well as using digital advertisements for job openings and efficiency with the ability to have work created quickly and efficiently and duplicated easily.

While innovative technology has been used in education to help students specifically the use of tablets and e-learning systems technology. In a workplace though such as a factory or powerplant technology is still very limited to simple computer based in an office mainly for reporting systems, which have become slow and outdated. The training as well is very outdated with the use of the same hefty paper manuals, which are complicated and not practical in a factory or powerplant workspace.

Conclusion
The research into education theory has given us more of an understanding on how people learn especially in vocational education. In regards to the education system already set up by Alstom when creating our new user manuals this training system is something we could possibly use, be inspired by or use as a base. With vocational education as well the research has made us release how when creating the user manual we have to have in mind the person we are trying to educate and the best methods to use for that person.

TECHNOLOGY

There is a market leading company called metaio, which offers a Software Development Kit that allows to create Augmented Reality Smartphone Applications. Furthermore, the kit also allows to create applications for wearable Android devices like the Epson Glasses.

The one key difference between a smartphone and a wearable Augmented Reality application is that on a smartphone the augmented parts are superimposed on the realtime video of the camera, while on Glasses the augmented parts are layered on the transparent display. Both will need and use the cameras input to recognize the real world objects.

Markerless Tracking
For the software to recognize the valve which has to be repaired, we need to recognize the valve. Therefore a 3D Model of the construction is necessary. Usually when designing these power plant parts a CAD 3D Model is created and can therefore be used to track the object.

The state of wearable Android glasses
Currently there are more or less two Glasses available. In this project we will use the Epson Moverino BT-200, the other option would be the Google Glasses, which look a lot less impairing, but are inferior to the Epson Glasses from a purely technical aspect. Both feature the Android operating system, meaning an application develop¬ed for the Epson Glasses will also work on the Google glasses and vice versa.

USER INTERFACES

The user interface, in the industrial design field of human–machine interaction, is the space where interactions between humans and machines occur. The goal of this interaction is effective operation and control of the machine on the user's end, and feedback from the machine, which aids the operator in making operational decisions. Examples of this broad concept of user interfaces include the interactive aspects of computer operating systems, hand tools, heavy machinery, operator controls, and process controls. The design considerations applicable when creating user interfaces are related to or involve such disciplines as ergonomics and psychology.

Abbreviated UI, the junction between a user and a computer program. An interface is a set of commands or menus through which a user communicates with a program. A command-driven interface is one in which you enter commands. A menu-driven interface is one in which you select command choices from various menus displayed on the screen.

The user interface is one of the most important parts of any program because it determines how easily you can make the program do what you want. A powerful program with a poorly designed user interface has little value. Graphical user interfaces (GUIs) that use windows, icons, and pop-up menus have become standard on personal computers.

"A good user interface has high conversion rates and is easy to use. In other words, it's nice to both the business side as well as the people using it."

Important facts:
Intuitive and consistent design
Clarity
High responsivity
Maintainability // flexibility
Attractiveness

3. USER RESEARCH

USER - JOB DESCRIPTION...

Job Description

Name of the function:

Erection Chief Field Engineer, Supervision (EIII)

1 Tasks / Responsibilities / Authority
1.1 Function related Tasks & Responsibilities
The Erection Chief Field Engineer

- Manages erection works for a branch of one of his basic faculties.
- Manages personnel groups.
- Manages overall erection works (inspection / outage).
- Manages erection and/or outage crews.
- Takes the overall responsibility for the technical correctness of the product, in compliance with the specific instructions.
- Reports to his superior according to project organization.
- Performs all work according to Environmental Health & Safety-, Quality-, and Schedule
- requirements.
- Takes over the function of the “Nominated or Appointed Person”, in terms of EHS Procedures (e.g. Lockout – Tag-out, Permit to Work, Non Routine Lifting operation etc.) and can thereby be the holder of a PTW within the delegated scope of work.
- Prepares, introduces and monitors erection strategy.

Details on tasks and requirements and/or rules are described in the Management System. For the different business cases the project specific field service order is to be considered.

1.2 General Tasks & Responsibilities
The general tasks and responsibilities for this function includes, but not limited to the following.
Assures works are proceeded in compliance to the Alstom`s environmental, health & safety rules, Management system and Alstom`s Code of Ethic.
Job briefing at home base according to checklist and project requirements. Manages supervision for erection personnel in regard to...

• Erection schedules, documents and procedures within branch/erection.
• Coordinate take over from civil and/or equipment/ systems from operation and take over from material handling/warehouse.
• Expertise and experience, to ensure performance complies with quality control, contract and equipment/system specifications.
• Coordination of all erection tasks with consultation of the respective faculty lead.
• Control of erection work, log-out /tag-out process, assure availability of necessary erection documentation and hardware.
• Implement EHS requirements according to EHS plan into all site activities. Verify standard activity risk assessment for all erection works for site specific use, prepare tool box talks with erection personnel, contractor / or customer personnel.
• Plan and prepare erection work with necessary tools and consumables.

USER - JOB DESCRIPTION...

• Assure that equipment, instruments and tools are handled according to instructions.
• System walk downs, inspection of carried out work and handover within requirements.
• Support the project in working cost efficiency.
• Technical issues associated with ALSTOM supplied equipment.
• Support commissioning and/or operation as requested.

Manages and coordinates with ALSTOM personnel in regard to:

• Assure quality and reporting control of erection personnel groups/crews assigned.
• Manage goals and competences. Control results and implement corrective actions, if necessary.
• Manage daily logbook with all relevant information regarding non compliances, work tasks, improvements, contractual issues, delays, working time etc.
• Attend / organize meetings as required by the project and/or construction management.
• Assure communication with ALSTOM home base.
• Assure Field Service and site regulations are obeyed.
• Monitor and control the quantities and milestones for progress reporting and invoicing.
• Assure feedback information to home base offices.
• Implements the Site Infrastructure for his faculty.
• Build up a suitable Customer relationship.

- Manages document control according to project requirements and timely preparation of record copies.
- Reviews Q- Document Package, prepared from the erection personnel, contractor / customer and hands it over to the relevant persons within the project organization.
- Coordinates with the Site Manager / Customer on status of work.
- Manages works with Assessment personnel as required.
- Issues and executes change or field work orders, technical claims and non conformance reports.
- Assures compliance of work time regulations.
- Cooperates for a smooth running of Site activities and their handling over to commissioning including relevant documentation.
- Manages the administration, handling of material and inventory of consumables and tools on site.
- Takes up opportunities to improve outcome. Traces and collects all extra costs as requested by the project.
- Provides training support for ALSTOM personnel as requested by line management.
- Provides a performance feedback for all erection personnel assigned to him.
- Provides a Site assessment to Project Management
- Checks time sheets of ALSTOM personnel and control signed off.
- Field service reporting required from Project Manager Outage
- Job de-briefing at home base according to checklist and project requirements.

1.3 Authority
- Right to give directions to personnel groups/crews directly assigned to him.
- Right to stop work if non conformity of work, quality, schedule and costs appears.
- Right to stop work if staff, material or environment is endangered.
- Right to require replacement of non qualified erection personnel, in agreement of the project and /or Site Manager.
- Right to request additional supervision if not sufficient with the agreement of the project and/ or Site Manager.
- Right to require replacement of non acceptable equipment / tools / techniques.

2 Requirements For The Function
E= Essential
D= Desirable

2.1 Education, Training, Qualifications
E: Apprenticeship, preferably in a metal /electrically processing occupation, comparable to:
International Standard Classification of Occupations (ISCO-88) codes for Erection Field Engineer (EFE) are the ones under Mayor Group 7 “Craft and related Trades Workers”, specially the ones under subgroup 72 “Metal, Machinery and related trades workers”) as required.
- Issues and executes change or field work orders, technical claims and non conformance reports.
- Assures compliance of work time regulations.
- Cooperates for a smooth running of Site activities and their handling over to commissioning including relevant documentation.
- Manages the administration, handling of material and inventory of consumables and tools on site.
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USER - JOB DESCRIPTION

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2 Requirements For The Function

E= Essential
D= Desirable

2.1 Education, Training, Qualifications

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International Standard Classification of Occupations (ISCO-88) codes for Erection Field Engineer (EFE) are the ones under Mayor Group 7 “Craft and related Trades Workers”, specially the ones under subgroup 72 “Metal, Machinery and related trades workers”)
E: Mech. / electr. Technical Engineer (certified Engineer)
E: Has progressed within the Alstom Field Service Organization and meets the Skill /
Experience / FET Training & Certification, required for this position.
E: Two (2) to four (4) years experience as a Erection Lead Field Service Engineer
D: Readiness for Multi Skill Training (e.g. different Product or other faculty)
D: Readiness for Site Manager Training
D: Readiness for Expert Development Program (Principal Engineer)

2.2 Experience and Work-Related Skills

E: Excellent knowledge of Alstom `s specific products
E: Excellent knowledge in leading persons / groups
E: Knowing Field Service internal processes & business rules
E: Knowing Alstom`s “internal” Networks to Engineering & Project Management
E: Knowing Alstom`s “external” Networks to Field Service Operation / Field Service Center
E: Ability to take over fully responsibility for technical correctness of work carried out
E: Ability to handle complex work-packages to success
E: Good command of written and spoken native language.
E: Good command of written and spoken English
D: Good IT skills (Word, Excel, MS Project, Power Point, Outlook)

2.3 Interpersonal and Social Skills

E: Ability to work in different countries / cultures
E: Ability to work according to a time schedule, meet deadlines.
E: Ability to motivate people
E: Ability to take / call for responsibilities
E: Good management skills
D: Good negotiation and presentation skills
D: Willing to train other persons according to the requirements of Field Service Product workbook.

2.4 Other Characteristics

E: Good skills in leading and /or assess people, customer or sites
E: Knowing of cultural differences
E: Readiness to travel
E: Readiness to work overtime and on weekends if required
E: Flexible
E: Good skills in Reporting
E: Good time management
D: Customer-oriented
D: Good skills in communicating / Conflict resolutions.

PERSONAS

Name: Edward Murphy
Age: 42
Job: Engineer

Edward is a very dedicated employee for Alstom and has worked for them for 20 years. While completing work Edward finds the reporting system tedious being more used to hands on work. His lack of interest in the reporting means he makes regularly mistakes which he has to then spend more time going back and correcting.

Edward is also asked regularly to help with training of new employees and finds the current user manual hard to teach with.

Goals:
Edward wants to share his knowledge about Alstom processes and on-site work to less experienced workers.

Fears and Frustrations:
Edward has a wife and three children waiting at home and he sometimes fears to get injured while working. He is a little bit frustrated because he thinks, security for on-site workers could be improved.

Tech Skills: 6/10

●●●●●●○○○○

Engineering Skills: 9/10

●●●●●●●●●○

Name: Lena Fiehman
Age: 22
Job: Apprentice

Lena while in college completed a short engineering program which she full enjoyed but made her want to broaden into a larger industry which lead her to join Alstom's training program.

Lena has a passion for new tech and is never far behind in the newest innovations. So the current user manual Alstom uses Lena finds old fashioned not being used to a paper manual having went mostly digital in her day to day life.

Goals:
Lena wants to learn as much as possible. She is also motivated to apply knowledge of here study at Alstom.

Frustrations and Fears:
Lena doesn't like waiting for new tasks. Since she wants to collect as many experiences as possible, she hates to to repetitive tasks for a long time.

Tech Skills: 8/10

●●●●●●●●○○

Engineering Skills: 3/10

●●●○○○○○○○

The personas that we created helped us in understanding what type of people could possibly use the final interface and how we could design it around them. The personas we created range from an experienced engineer to a new apprentice showing us the challenge of creating an interface for a wide age range as well as job experience.

PERSONAS

Name: Benedict Cash
Age: 37
Job: Crane Operator

Benedict has only worked at Alstom for 1 year and therefore is still getting used to all of Alstom's systems and how they work.

Benedict though while on a job would like to have clearer communication with the ground team at time so he can plan his timing better. As well he thinks having clearer images of what is going on below would help him. Benedict though does not have that much experience with new tech and therefore is very wary of any new systems coming in that might be too complicated.

Tech Skills: 4/10

●●●●○○○○○○

Engineering Skills: 5/10

●●●●●○○○○○

Goals:
Benedict wants to do his work with a competent team in an efficient way.

Fears and Frustrations:
Benedict doesn't like if he feels insecure during work. He could cause a lot of damage with the crane. Therefor he wants to know as many things as possible about the work in progress to operate the crane in a safe way.

Name: Markus Rossi
Age: 57
Job: Control Room Operator

Markus has worked at several companies during his working life and has been at Alstom for the last 5 years. When looking at the reporting system Markus believes a clearer simple version is needed which is more digital with images and video.

Markus also feels the current user manual which Alstom uses is very outdated and a new approach is needed. Markus keeps up with tech as best as he can but feels like any new tech systems coming in have to be clearer and simpler.

Tech Skills: 7/10

●●●●●●●○○○

Engineering Skills: 10/10

●●●●●●●●●●

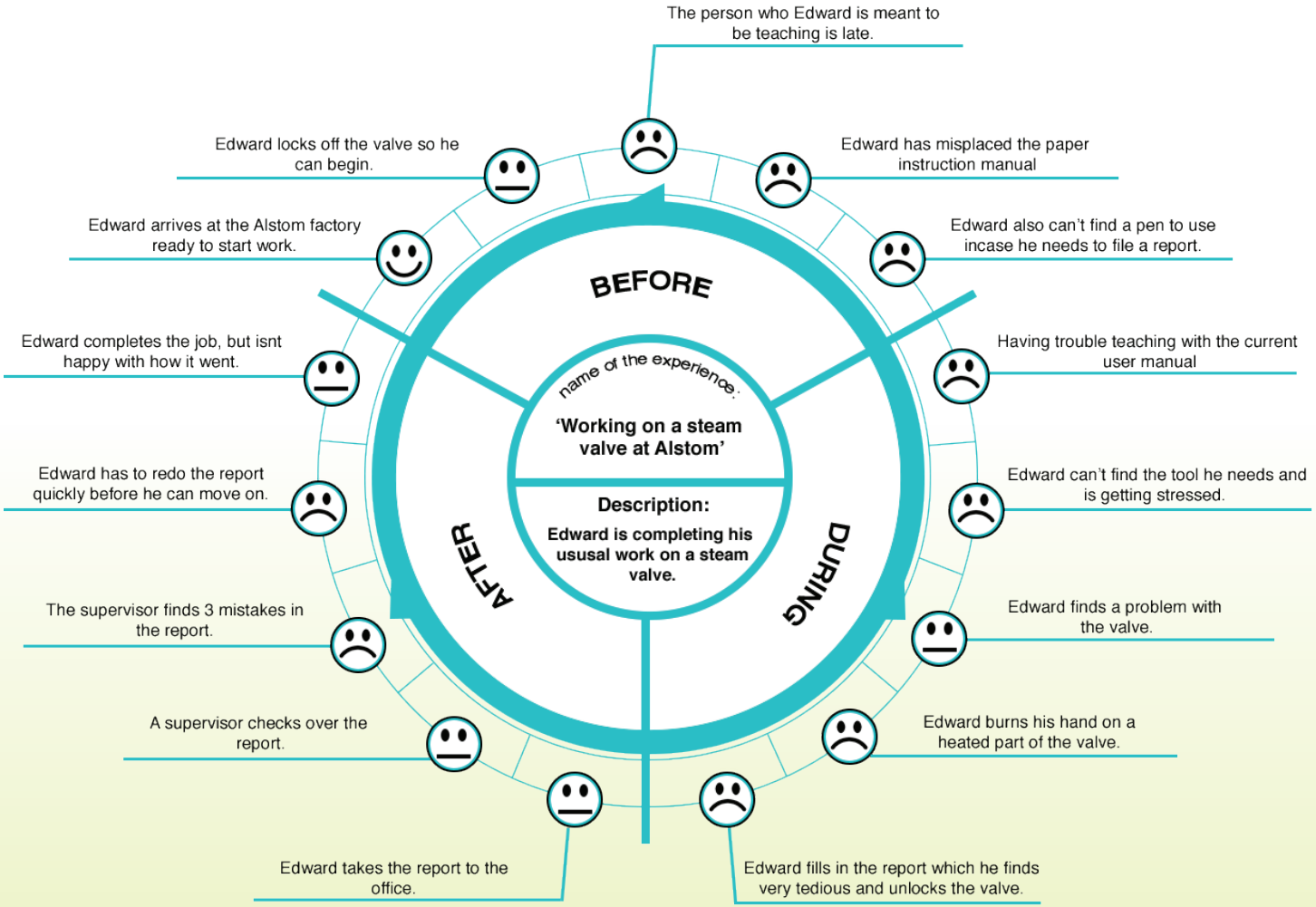
Goals:
Since he is a control room operator and has some responsibility for his team there, he wants to have the best products to work with.

Fears and Frustrations:
Markus Rossi witnessed two serious accidents at work in his career. He is frustrated about the quality of some systems and helps improving them to increase the security at work place.

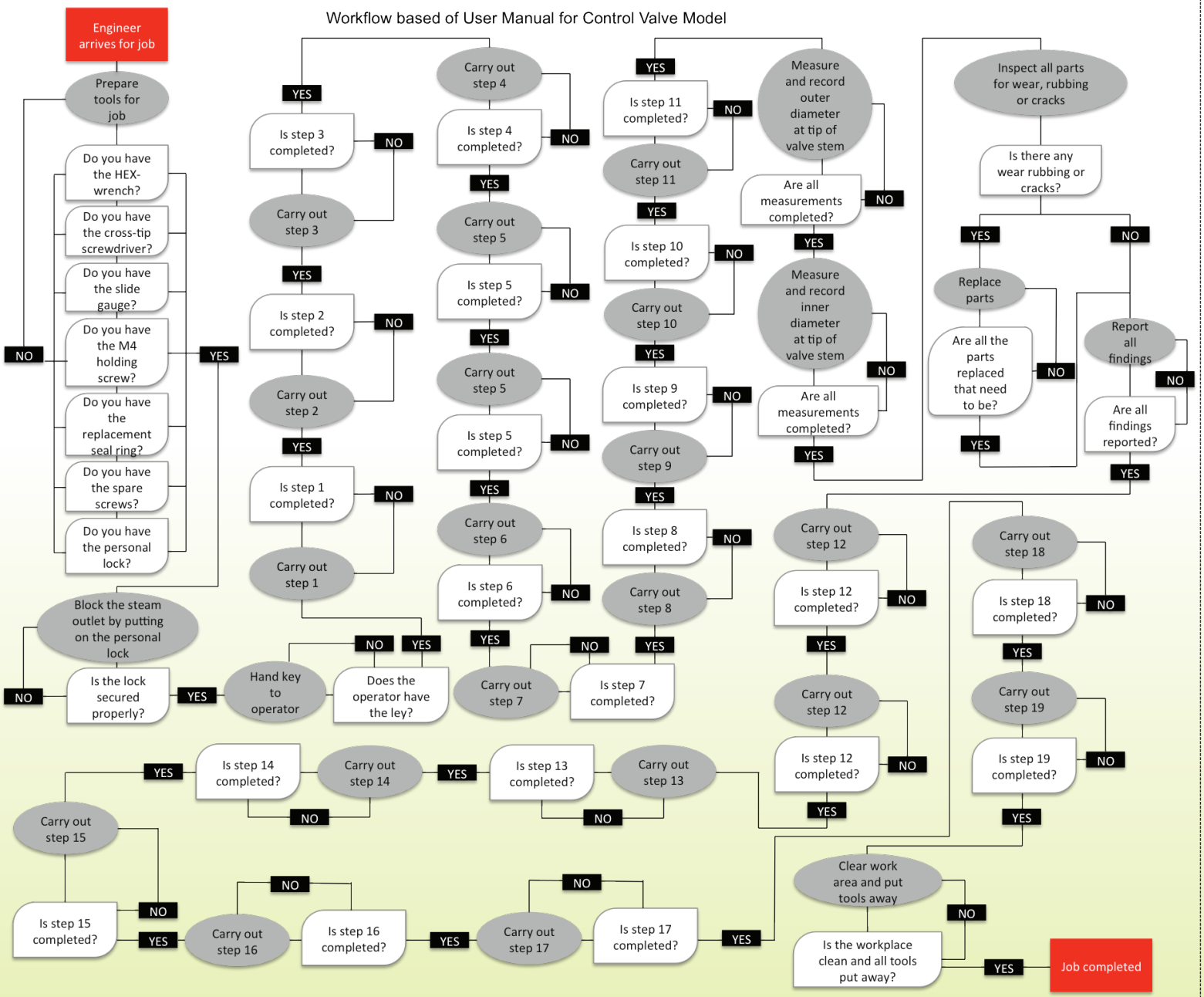
CUSTOMER JOURNEY MAP

In order to gather a better understanding of the user, we decided to draw up a customer journey map. This allowed us to see the journey of 'working on a steam valve at Alstom' from start to finish and uncover the pain points applicable to the job. This allows us to then take these flaws into account for when we are designing our prototype for the glasses, making sure we turn the experience into a much more fluid, effortless experience.

The journey begins with Edward arriving at the Alstom factory, where he has a valve to repair. The majority of the job Edward isn't too happy as the problems keep popping up. From misplacing the manual to making mistakes in the report, the problems for Edward, keep coming. This journey map allows us to unearth some of the users problems and allows us to design for these user needs, which will hopefully making the experience of repairing a valve at Alstom a much happier experience.



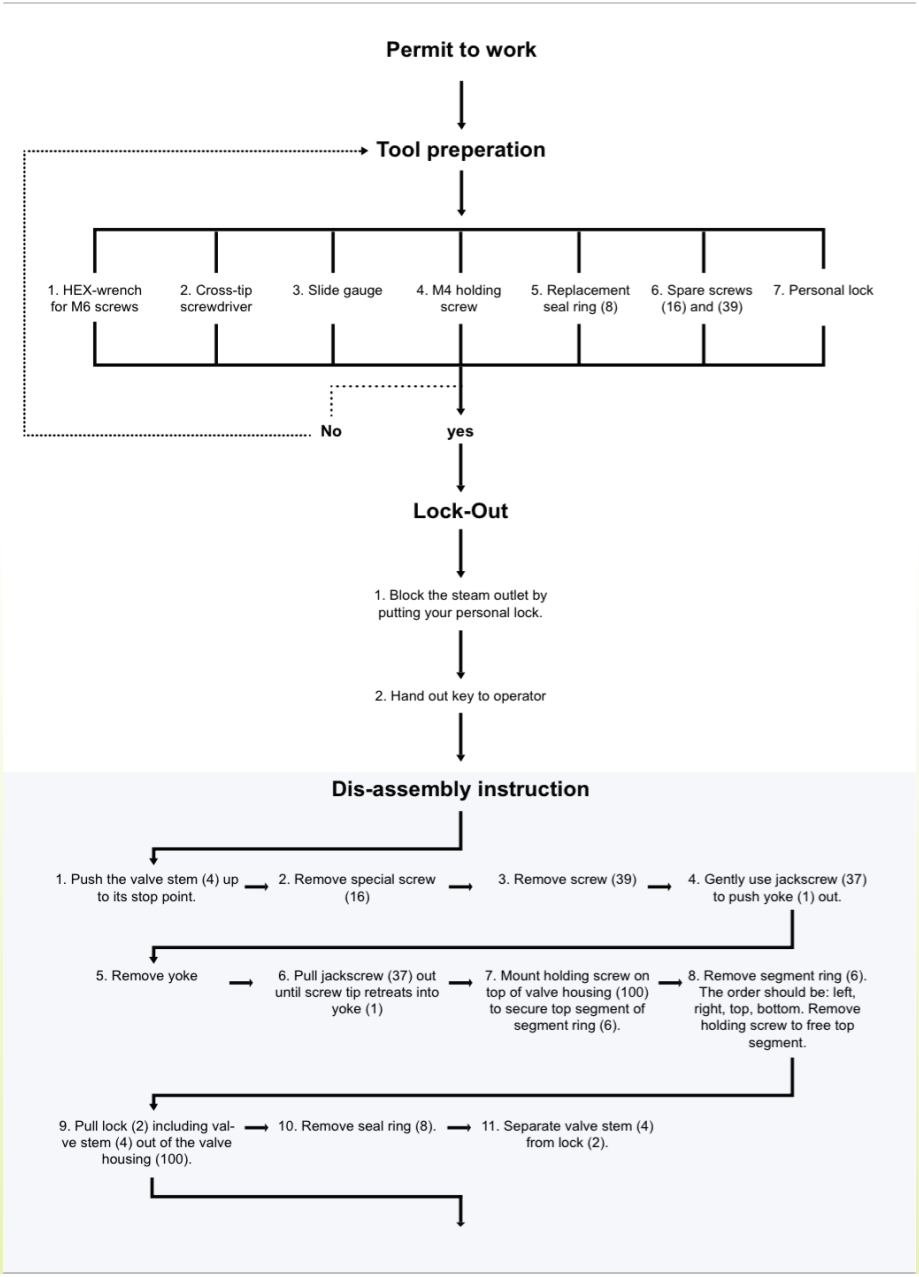
WORKFLOW

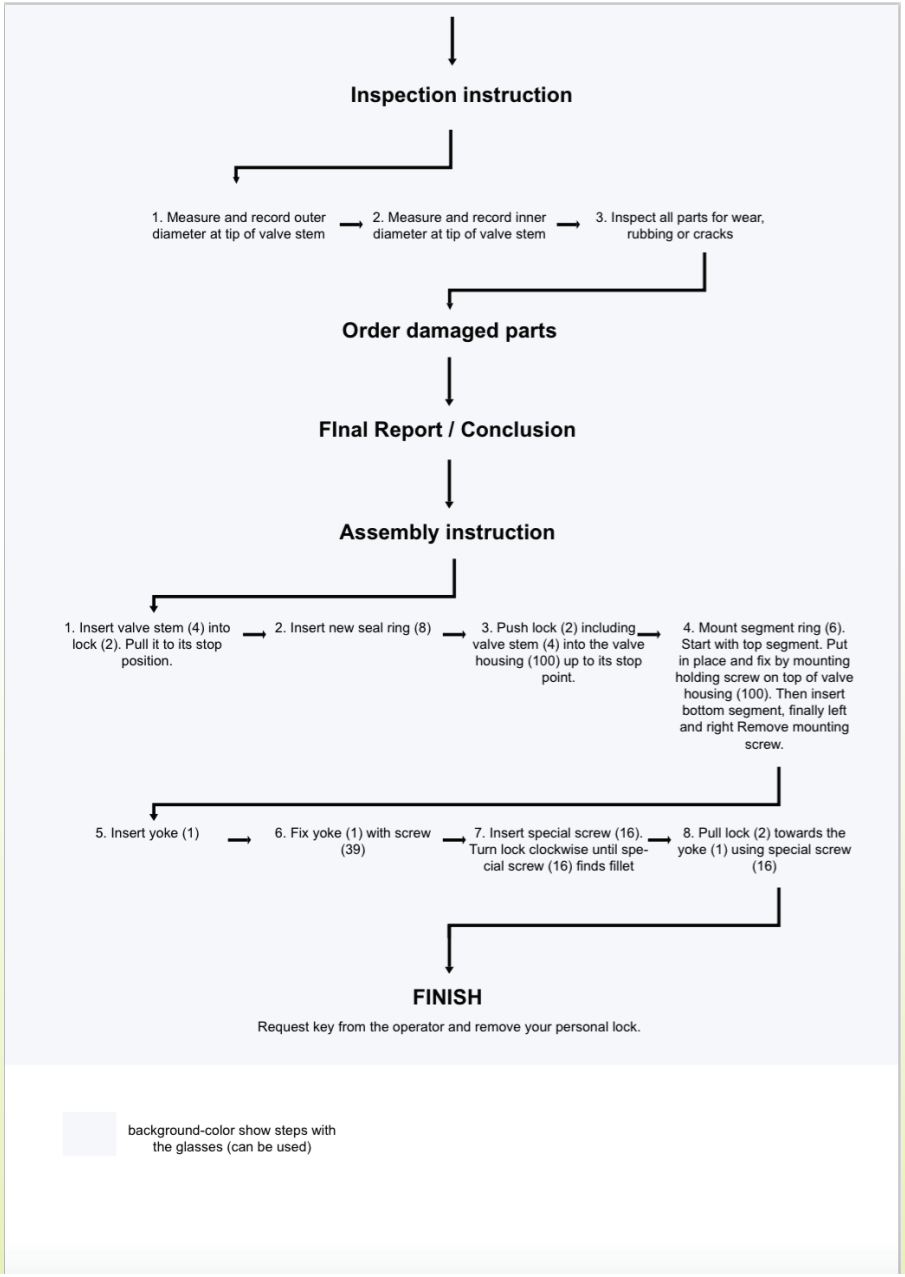


Disassembly and Assembly instructions steps numbered

1. Push the valve stem up to its stop point
2. Remove special screw
3. Remove screw
4. Gently use jack screw to push yoke out
5. Remove yoke
6. Pull jackscrew out until screw tip retreats into yoke
7. Mount holding screw on top valve housing to secure top segment of segment ring
8. Remove segment ring. The order should be: left, right, top, bottom. Remove holding screw to free top segment
9. Pull lock including valve stem out of the valve housing
10. Remove seal ring
11. Separate valve stem from lock
12. Insert valve stem into lock. Pull it to its stop position
13. Insert new seal ring
14. Push lock including valve stem into the valve housing up to its stop point
15. Mount segment ring. Start with top segment. Put in place and fix by mounting holding screw on top of valve housing. Then insert bottom segment, finally left and tight. Remove mounting screw.
16. Insert yoke
17. Fix yoke with crew
18. Insert special screw. Turn lock clockwise until special screw finds fillet.
19. Pull lock towards the yoke using special screw.

WORKFLOW DEVELOPMENT





STAKEHOLDER ANALYSIS

The stakeholder's analysis on the left shows a detailed look at who are our stakeholders and what there priorities and interests are. The table outlines the stakeholders who include:

- On-site workers
- Report managers on-site
- Health and Safety managers
- Power plant managers
- Control room operators
- Service center assistance

All of the stakeholders are then analysed against several interests which are:

- Safety
- Task
- Financial
- Time
- Report

For each interest they either apply to the stake-holder or not and from first glance the stake-holder with the most interest are the report mangers on-site and the power plant mangers who have a stake in every interest.

Stakeholders	Interests				
	Safety	Task	Financial	Time	Report
On-site workers	Workers will have specific health and safety regulations they will have to follow while completing the task.	The workers will be the direct contact with the machine while the task is carried out.		Workers have to complete the job as quickly and efficiently as possible while at the same time abiding by rules and regulations according to health and safety.	After completing the task workers have to carry out a final report describing how the task went and what problems if any came up.
Report managers on-site	Mangers on-site regulate that all workers abide by the health and safety rules as well as organising permits for work.	Mangers oversee the task and monitor start, during and completion of task.	Mangers make the task as quick and efficient as possible reducing cost damages with the machine un-operational.	Mangers monitor time that the task takes and keeps workers on a deadline.	Mangers give permits to work and hold lock out key while work is completed. Report of how the task went is also analysed by the manger and edited as necessary.
Health and safety managers	The health and safety mangers monitor the H&S regulations within the plant and report any problems, accidents or events	The task at hand can be very dangerous so H&S managers have to be extremely vigilant.			The managers analyse the report after job completion and if any accidents occurred deal with the repercussions.
Power plant managers	Mangers outline health and safety rules and regulations in a company policy.	The mangers dictate the task to on-site mangers and workers.	The managers use the finances to fund the maintenance and repair of the machine. As well they monitor how many days the machine is not working because there is financial loss for the company.	With financial loss for having the machine not working mangers want the task to be completed as quickly and efficiently as possible.	The reporting system gives mangers a way to monitor work throughout the year and find if there is a more efficient way the power plant could be working.
Control room operators	Control room operators monitor health and safety of workers while they complete the task.	Within the control room the operators monitor the task being completed but in particular the heavy machinery needed for the task like the crane.		The operator needs to monitor the task progress and make sure deadlines are met.	Operators add to the report after monitoring the task and work with the heavy equipment.
Service center assistance		While the task is being completed the service center is available to contact by workers or on-site mangers to ask for advice or help.			

TASK ANALYSIS

How task is accomplished

The task that has to be carried out is to disassemble, inspect and assemble the control valve for a stem valve. To accomplish this it is done in a step-by-step process, which has a total of 24 steps, which are shown below. The disassemble steps are highlighted in red, the inspection steps are highlighted in orange and the assemble steps are highlighted in green…

1. Push the valve stem up to its stop point
2. Remove special screw
3. Remove screw
4. Gently use jack screw to push yoke out
5. Remove yoke
6. Pull jackscrew out until screw tip retreats into yoke
7. Mount holding screw on top valve housing to secure top segment of segment ring
8. Remove segment ring. The order should be: left, right, top, bottom. Remove holding screw to free top segment
9. Pull lock including valve stem out of the valve housing
10. Remove seal ring
11. Measure and record outer diameter at tip of valve stem
12. Measure and record inner diameter at tip of valve stem
13. Inspect all parts for wear, rubbing or cracks
14. Record any wear, rubbing or cracks on all parts
15. Replace any damaged parts
16. Separate valve stem from lock
17. Insert valve stem into lock. Pull it to its stop position
18. Insert new seal ring
19. Push lock including valve stem into the valve housing up to its stop point
20. Mount segment ring. Start with top segment. Put in place and fix by mounting holding screw on top of valve housing. Then insert bottom segment, finally left and tight. Remove mounting screw.
21. Insert yoke
22. Fix yoke with crew
23. Insert special screw. Turn lock clockwise until special screw finds fillet.
24. Pull lock towards the yoke using special screw.

When following out these steps the user has to follow them precisely with no deviations so that the task is carried out properly. As well the steps can not be changed or altered meaning that for our deign for a new user manual we will have to make sure to follow these original instructions precisely and only create a new way that the information is given.

Detailed description of both manual and mental activities
For the task there are a lot of manual activities that the user has to accomplish with the task being very engineer orientated. The main manual activities that the user would carry out are the disassemble and assembling of the control valve which would involve the use of a variety of tools and machines including a crane.

The manual activities could be quite strenuous for the user especially if they are not familiar with the task, for example an engineer who has not worked with the machine before. As well the size of the machines makes some parts very heavy and impossible to move without the help of a crane, which needs to e operated correctly and safely.

Mental activities that the user will find while carrying out this task are the reporting and health and safety aspects, which need to be taken into consideration. The reporting system covers mainly the inspection stage where the engineer will have to know what to look for when inspecting parts for any wear, rubbing or cracks. As well for the reporting all thoughts and comments about the job have to be recorded.

The other mental activities that the user will have to consider are the health and safety aspects of the task. The mental activity is mainly the user being very aware at all times of the task they are doing and how to keep themselves save in the environment they are in.

TASK ANALYSIS

Task and element durations

Within the task are a number of steps which need to be carried out in order and the instructions precisely followed. The duration of the task overall is at the moment around 2 days giving the size of the machine. Time is also given to task before hand, which includes obtaining the permit for work, as well as after the job is done with final reporting of the job carried out.

Task frequency

The task is carried out quite frequently with inspections on the machine at least once a month. As well the task can be carried out if any problems occur. With the frequency the task is carried out engineers would become quite familiar with the task.

Task allocation

The task is allocated to a group of people who do their individual jobs within the task. The people the job is allocated for included 2 engineers, crane operator, crane helpers and possibly an apprentice engineer.
The 2 engineers would be carry out the main part of the task dong the step by step process that is necessary to disassemble, inspect and assemble the control valve.
The crane operator and his helpers will help position the cranes winches in place so that the larger parts of the control valve can be moved in or out of the machine.
An engineer apprentice would assist the 2 main engineers with fetching tools and noting thoughts and comments about the job. The apprentice would also use the task as a learning experience.

Task complexity

The task while defined using a simple step-by-step process is still a complex engineering job, which needs a fully qualified engineer in large machinery. The task also calls for several people to be working on one job.

Environmental conditions

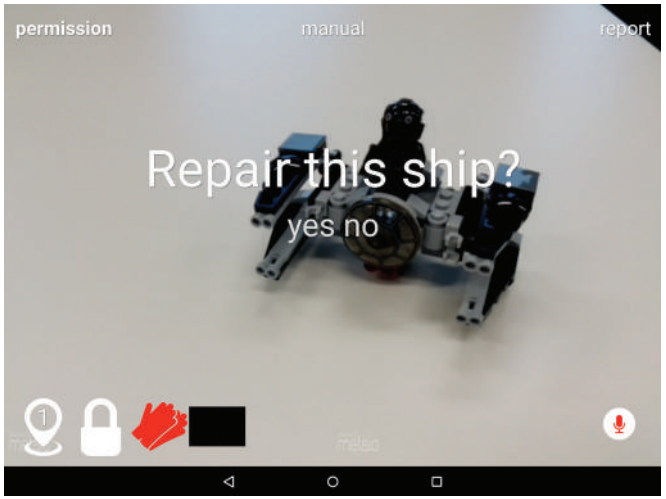
The conditions that the machine is in can be at times a very loud and the area which most of the work have to be carried out. Because of the possibility of a loud environment communication would be hard to accomplish and a better way to communicate using digital elements may help the user.

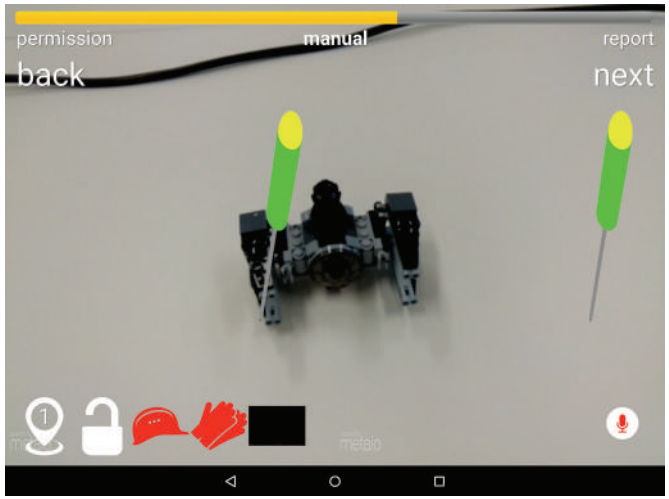
Necessary clothing and equipment

Because it is factory environment safety clothing is a must and all workers will need to have all there safety gear on properly before being allowed in the work area. The type of safety wear that is needed is a hard hat, steel toed work boots, high visibility jacket and safety glasses.

4. TECHNOLOGY DEVELOPMENT

LEGO TASK





The Lego Task was used to get a feeling of how Augmented Reality applications work. Soon I (Matthias) decided that the Metaio SDK was best suited for an AR application. Since the glasses run Android, I decided to develop with the native Android Template included in the SDK.
As usually the start was the hardest part, since I had to read the whole documentation first to get a glimpse of what is possible. After this I started creating a simple application that recognizes markers and augments objects on there. Since the ship was an actual real world object, it could not be recognized using marker based tracking. So marker less tracking was necessary. 3D CAD tracking was possible at this time, but still in Beta phase and really slow. Therefore, I decided to go with Instant 3D SLAM tracking. This allowed me to simply create a tracking file of any object on an Android device. The tracking files can then be included in the project and individual objects are recognized. Also, the tracking configurations match the camera used to record the files, so that it's more accurate. Calibration is done on the device as well. Tracking multiple objects at once was also implemented during the Lego exercise and has us later allowed to track dangerous objects and warn the user. Because we also wanted a good interface which allows the user to have both hands free, implementing speech recognition was necessary as well. Continuous recognition using the android.speech interface isn't encouraged, since it drains the battery and connects to the internet all the time. Since these limitations didn't matter too much in our project, I implemented the speech recognition interface. If the network connection is good, the recognition works pretty well and it's possible to navigate the application without anything other than speech. An icon in the bottom right corner gives feedback to the user whether he is being heard by the device.
Communication with the user is mainly done through text messages and icons. For this I implemented special interfaces and patterns, which are described in the user interface part of this document.

PROTOTYPE DEVELOPMENT

We worked with the Lego objects for a long time, since it allowed to try all the regular interface parts. The switch to the valve didn't require a lot of work, just a different tracking configuration.
Some of the augmented objects had to be adapted to the valve, so that the user knows what to do. Also in this phase I implemented the possibility to take screenshots automatically during the procedure. These shots are displayed in the end and are uploaded as a report after confirmation.
I planned to debug the prototype on my tablet and later make sure that everything works on the glasses as well. Theoretically everything that works on the tablet should also work on the glasses. After Christmas I finally tried the application on the glasses. Installation was pretty easy, but the background wasn't yet transparent. After I activated the see-through mode, it was possible too only see the augmented parts on the screen, with the rest transparent. Unfortunately the glasses don't support transparency and the screen just turns black, which pretty much allows the user to see-through. Also it showed a message indicating that speech recognition wasn't supported. After some research I figured, that the speech interface simply wasn't installed yet and I did just that. If this weren't enough also the earphones with the microphone were missing and I couldn't verify that speech recognition actually worked until one day before the presentation, when the other teams arrived and brought us their glasses.

5. 2016 DEVELOPMENT

IDEA DEVELOPMENT

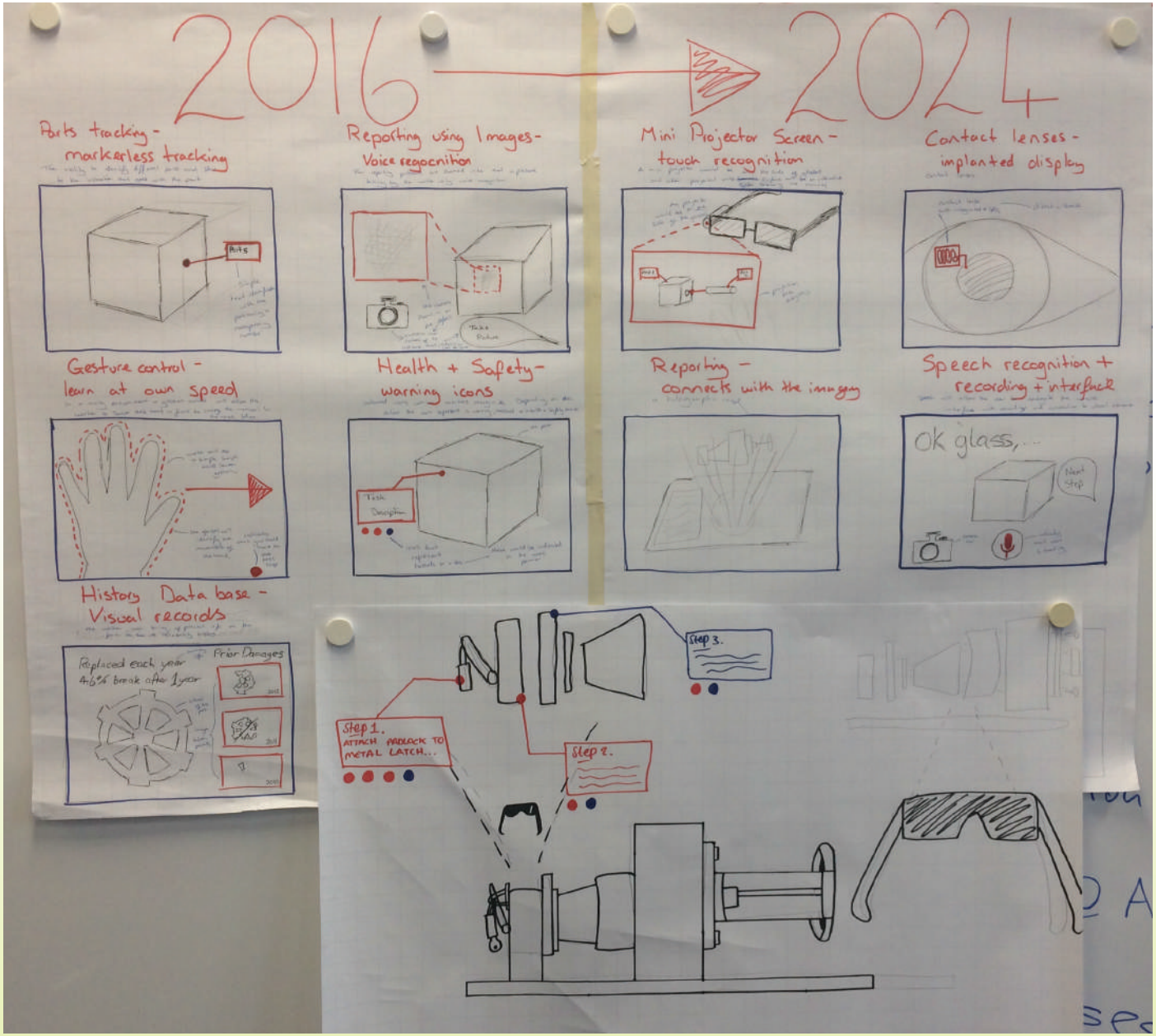
To start the project and get us thinking about what we wanted to create we first created a large poster with first visuals and notes on ideas we could encompass in both the 2016 concept and the 2024.

Our first 2016 concepts which we presented were;

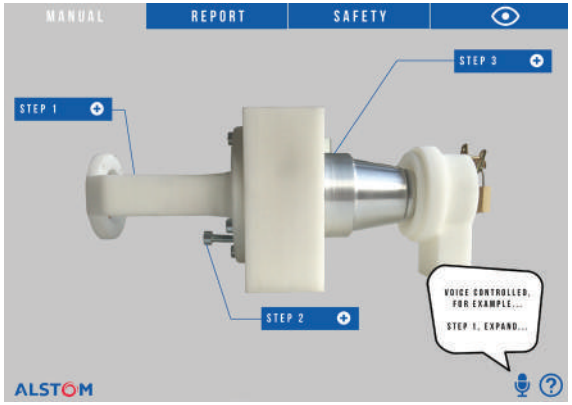
- Markerless tracking – allowing parts identification.
- Voice Recognition – to support reporting systems and navigation.
- Gesture control – for hands free navigation.
- Health and safety – early warning system for users.
- Report history – visual records which users can search and view on the glasses.

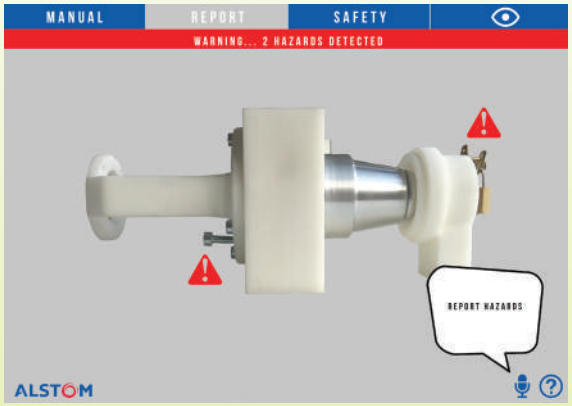
Our first concepts for 2024 which we presented were;

- Interactive projections – allowing interface interactions on any surface for note taking and reports.
- Contact lenses – with an implanted display making the user the system.
- Holograms – holographic images of the machine which can be interacted with.



INITIAL DESIGNS





The next steps we took was to individually create visions of how we thought the 2016 might look at what elements may be present. Images 1-3 shows first wireframes crated by Aaron when we discussed these designs we liked the elements of showing the speech recognition in the corner, the addition of a button allowing the user to turn off the display and having as small a menu bar as possible. Image 5 shows another vision created by Sophie the main element shown which we liked was the health and safety hazard system. Then images 6 and 7 created by Julia depict the idea of the animation overlay on the machine and also a colour coded system. From these initial visions we were able to extract elements which should be included in the final designs. These elements included a hide screen button, animation overlay, colour coded elements and a health and safety warning system.

DESIGN DEVELOPMENT

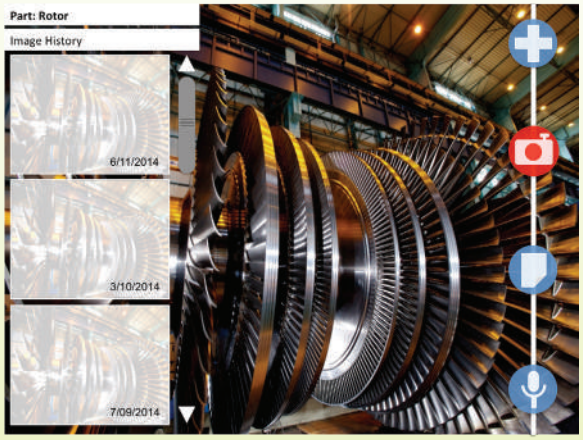
Creating a selection of wireframes was the next step the wireframe below was created by Sophie. These wireframes show the menu on the right hand side which after discussion it within the group is a design element we kept for the final design.

1. The wireframe above depicts how the speech recognition is highlighted allowing the user to navigate the interface hands free.

2. A concept for the reporting system is shown above with simple drop down selections and step by step questions allowing the user to navigate the reporting system easily with speech control.

3. The wireframe above is another example of the reporting system and how it is navigated using speech recognition allowing the user to work with the interface hands free.

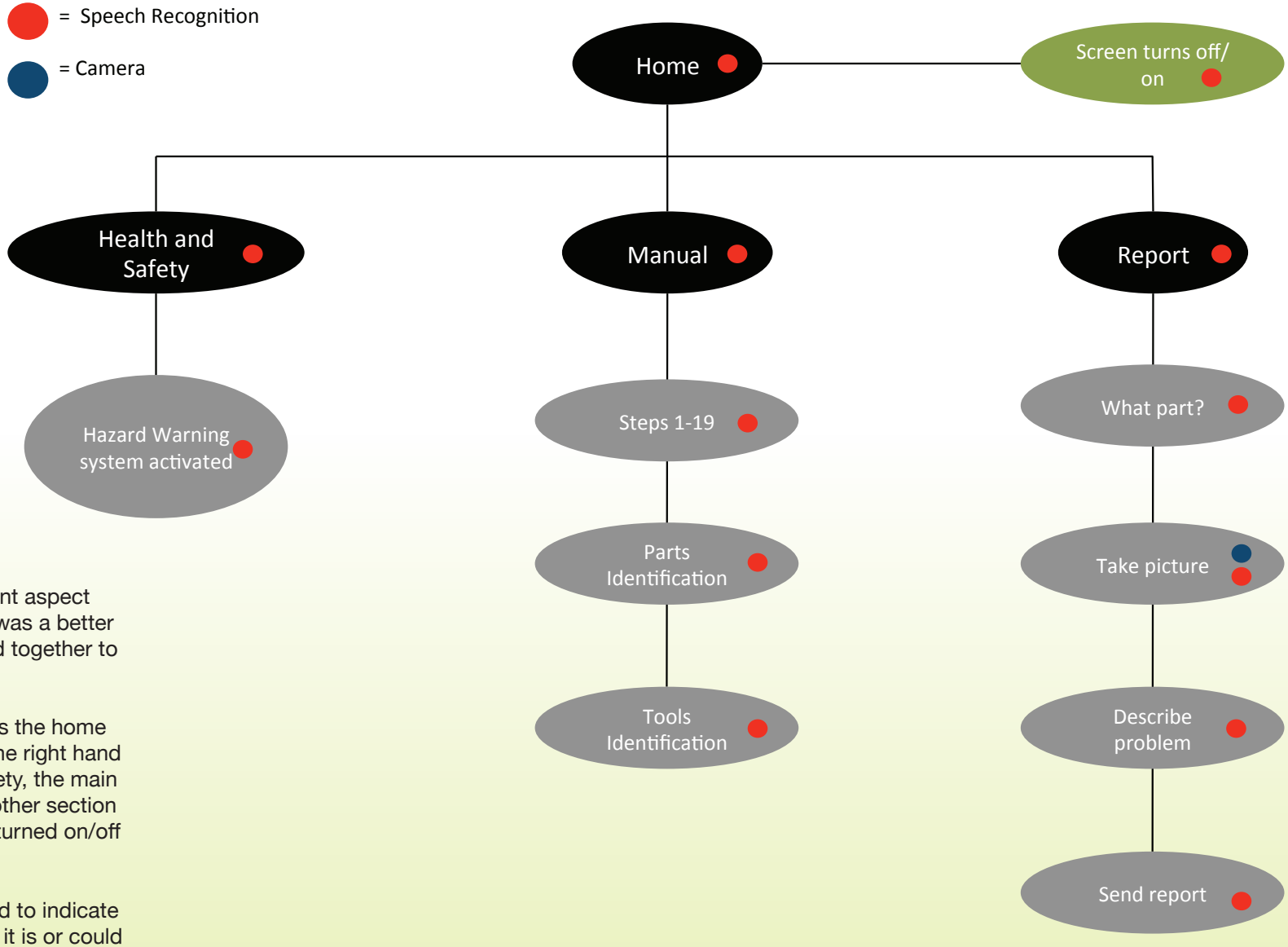
4. A camera setting allows users to contribute to the report with images and videos. This makes the report more interactive.



5. The report system then has a database of images and videos which you can search and review.

6. A final screen is a health and safety hazard warning system which gives real time information and protects workers while the task is being carried out.

SYSTEM ARCHITECTURE

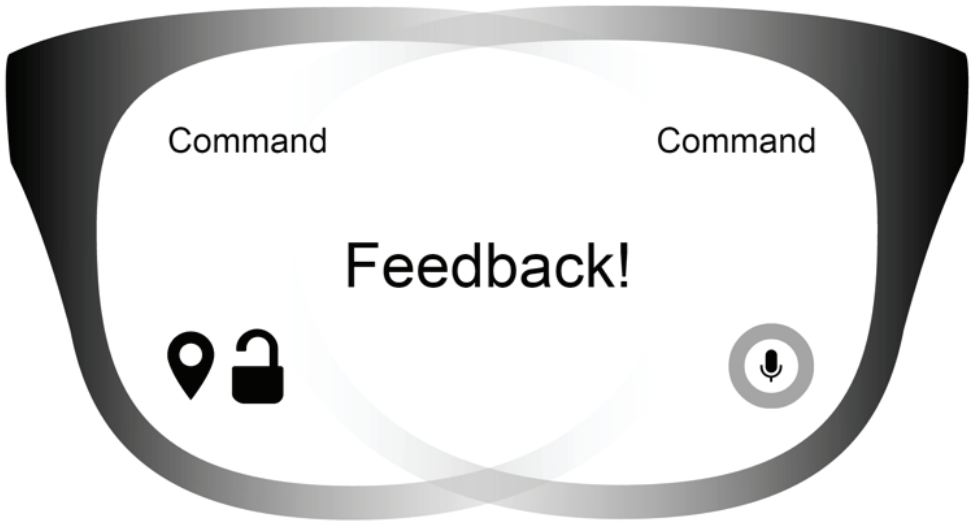


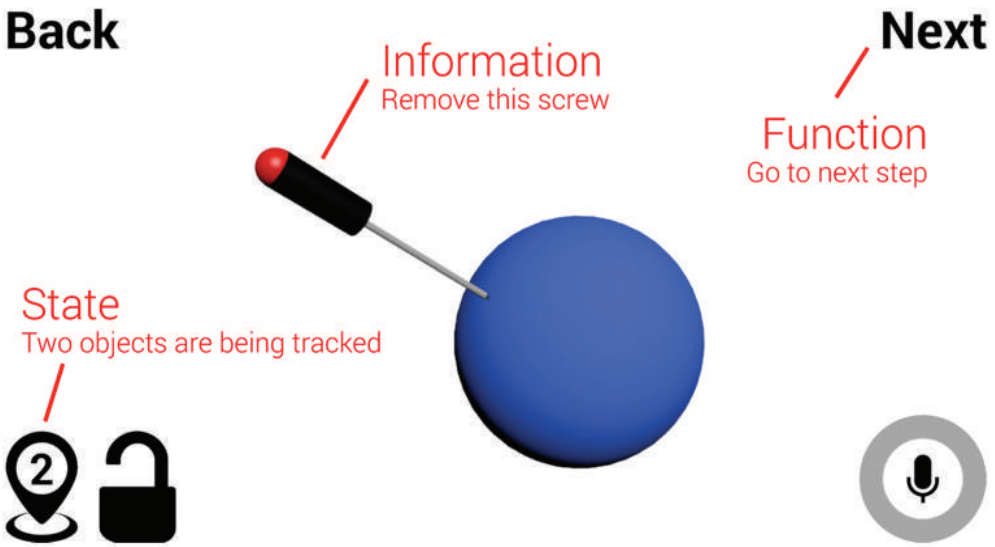
The system architecture was an important aspect which we completed what this gave us was a better understanding of how the screens linked together to create the final interface.

The main starting point for the workers is the home screen with a view of the menu bar on the right hand side. The menu includes Health and safety, the main manual and the report. There is also another section which indicates how the screen can be turned on/off and then return to the home screen.

On the diagram as well red dots are used to indicate the health and safety system and where it is or could be present. The blue dot then indicates where the camera would be used.

INTERFACE CONCEPT





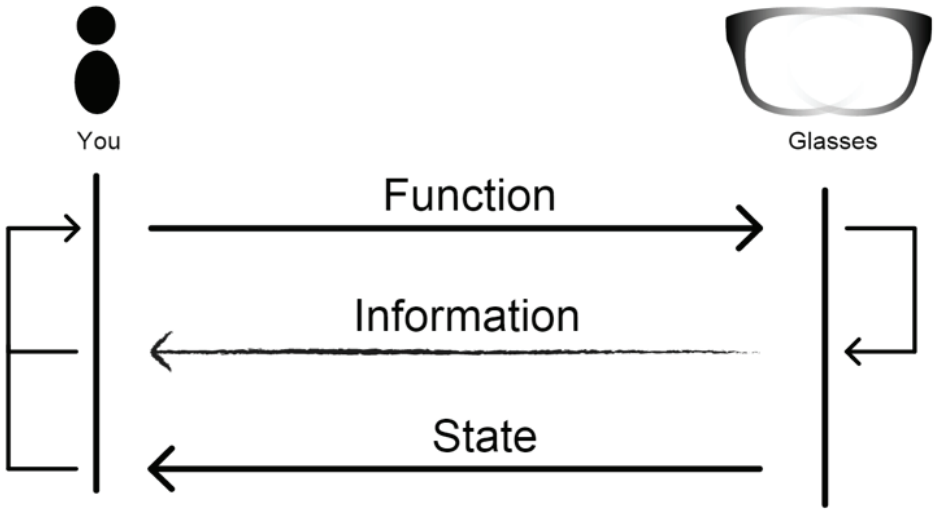
Until now the focus of case studies about AR maintenance applications lay more in the area of showing the instruction to the user using augmented objects. But once the procedure gets more complicated there is a need for more sophisticated user interaction.

For a good Augmented Reality experience the following need to be taken into consideration;
• The user can see the real world
• There is enough space available to show the augmented objects
• Augmentation mostly happens in the middle
Since our interface focuses on the execution of mostly mechanical tasks, there are some limitations.
• Tools may be held in both hands
• Hands are usually dirty
Because of these limitations the proposed way for user interaction will use only speech recognition for user input. The interaction will differ from human-to-human, in the sense that the words to be used are clearly defined and have a definite effect. One could say that the speech input method merely replaces physically touching buttons, as used on smart phones.

Separation of Concerns
The things on the screen can be divided into three categories;
• Information
• Function
• State

Information is the reason why you are using the glasses. Everything that can also be found in the instruction manual is information. Function elements let you interact with the glasses and tell them what information you need. Lastly, the state elements are the way the glasses give you feedback.

INTERFACE CONCEPT



In an Augmented Reality application the information lies in the objects being augmented onto the real world. But because not all of these objects can possibly be shown at the same time and not everybody wants to see the same things, there is a need for function and state elements on the otherwise transparent screen.
On touch or mouse interfaces you can recognize function elements as clickable buttons with text or icons in them, while state usually consists of plain icons or text. In the context of a speech interface icons have the problem, that each user will say a different word for the same icon. Therefore, the elements have to look like this:

Function
- Text

Information
- Augmented Objects

State
- Icons / Graphics

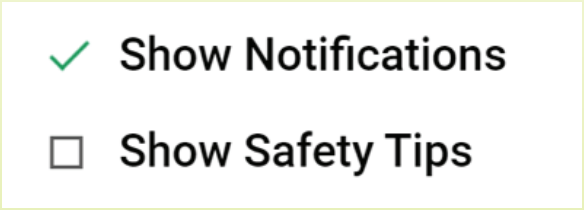
- Questions?
- Notifications!

If it's not possible to demonstrate all the instructions (information) using Augmented Reality, it's not recommended to use Smart Glasses. The cost of creating such an application would not be justified.

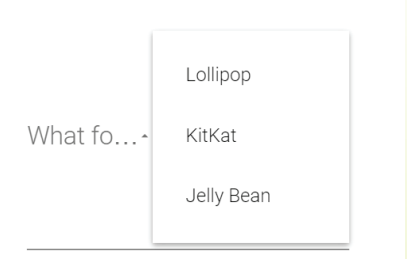
Common Interaction Elements

Here are some well-known Interaction elements from HTML ported to the world of smart glasses and speech recognition.

Checkbox



Select



INTERFACE CONCEPT

Readability

Big and bold

Readability

Medium with contrast border

Readability

Adapt color to background

Readabilty
Reading text written on top of the real world, which can have any color, can be difficult.

The choice depends on the case at hand. We went for the second one, with a black shadow around the white font.

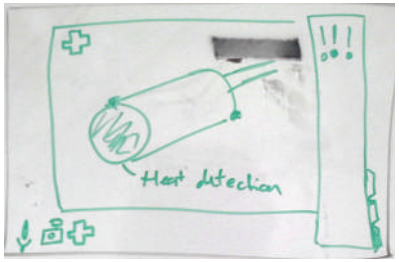
LOW-FIDELITY WIREFRAMES

After discussing our ideas we decided to divide the tasks with Fabi and Julia completing the 2024 concept and Sophie and Aaron completing the 2016 interface design. To start we went back to a basic wireframe pulling ideas together which we had got from the group .

1. For the main layout we went with the design of having the menu bar on the right hand side leaving a very clear space in the middle.

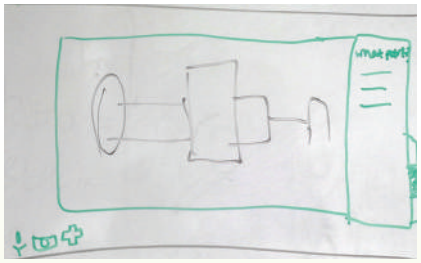
2. Another idea was to create a button which can turn off the main screen leaving a clear area to see through with no distractions.

3. One main part of the design was the manual in the design above the menu bar expands to show instructions for that step. An animation overlay is then in the center of the screen

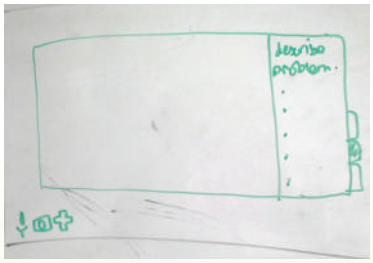


4. When discussing our concepts we decided to concentrate on the health and safety with a hazard warning system. This would respond in real time and turn on no matter what part of the interface you are on.

5. Another incorporated system of the health and safety was to have a check list of procedures which workers could follow. This would come up at the start and would not close until all the regulations had been met.

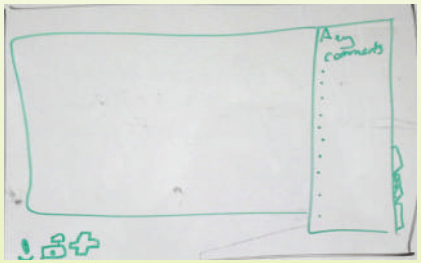


6. Another main body which we wireframed was the report system. Early on we decided on a simple step by step system which showed short concise questions for the worker to answer. The wireframe above is the first question 'What part are you you using?'

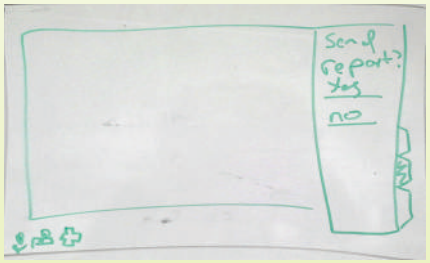


7. The next part of the reporting was for the worker to describe the problem. The report interface is the same as the manual with the menu bar extended.

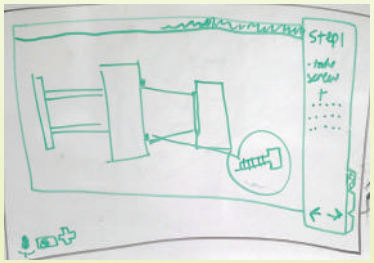
8. Taking a picture as well for the report is another element which will be included in the final design.



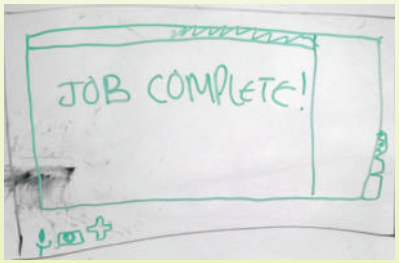
9. The interface as well gives shows in the bottom left corner symbols indicating the speech control, camera and H&S.



10. The reporting system will go through each step at the workers pace and then ask for confirmation at the end.



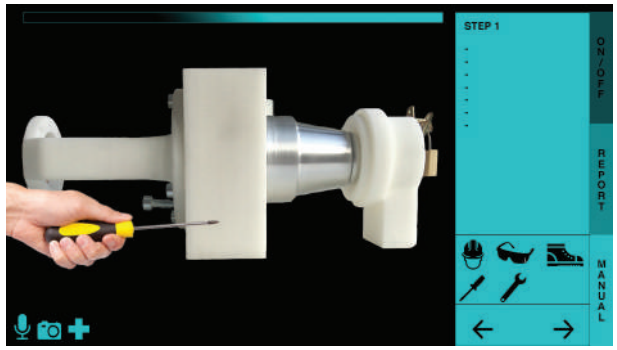
11. Another part of the manual system is the parts identification.



12. Once the task is complete the interface will tell the user and then reset back to the beginning.

MID-FIDELITY WIREFRAMES

With the creation of initial wireframes which included all the elements we wanted the next step was to create some hi-fidelity designs. We did this so that we could see better how the design would look on the screen. As well having colour variations and showing different ways to display information gave us a better understanding of how we wanted the interface to look in the end. The main elements which we definitely included were the manual, reporting, health and safety warning system and the ability for the worker to turn the screen of so that his vision is clear.

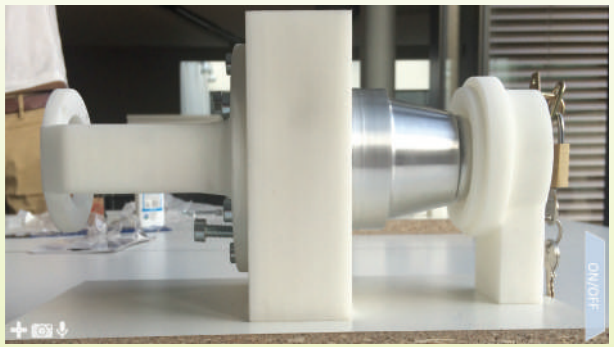


1. The wireframe above was created by Aaron and uses the ide we created of the menu bar on the right hand side. The menu bar then expands to show written instructions of the steps the worker has to take to complete the task. A new addition to the design at this stage was to add a progress bar which is at the top of the screen.

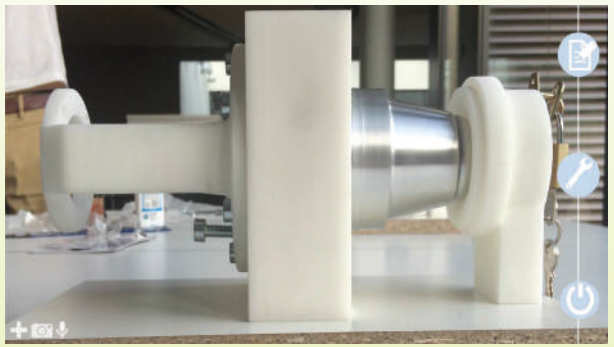
2. The image above shows the manual system again. On the bar on the right as well symbols are used to show the health and safety gear that the worker needs to be wearing for this task and what tools are needed. A simple symbol based system makes it easy to recognize and interpret.

3. After receiving feedback on the design we created the menu bar was changed in terms of colour and opacity to make it softer and easier to see through the glasses.

4. Above are wireframes that Sophie created using the same initial wireframes. These are laid out much the same as the first but the colour scheme has changed and the menu opacity is lower.

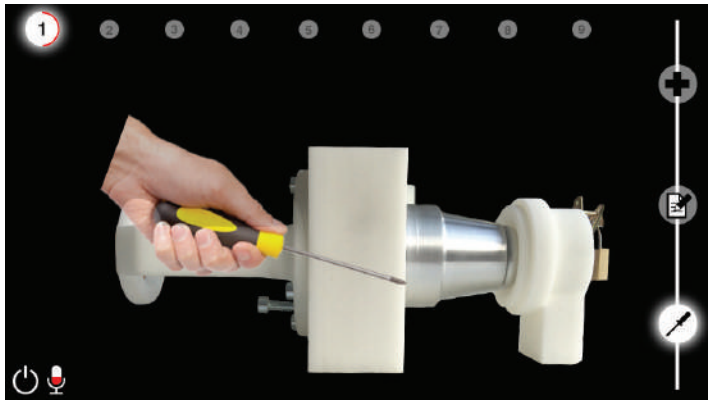


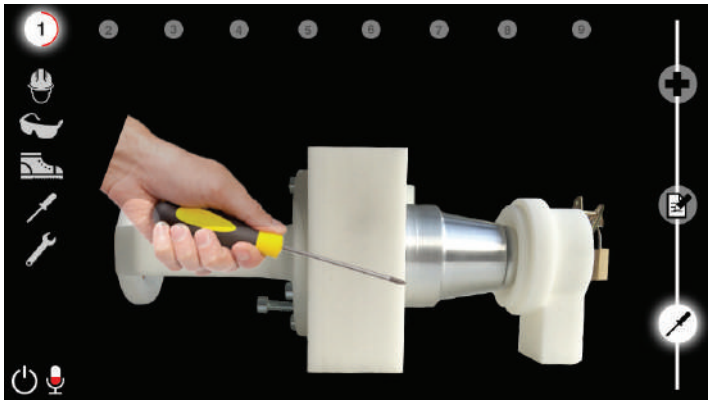
5. The screen above show how the screen can be cleared with the on/off button. This helps show the full screen that the worker sees through the glasses.

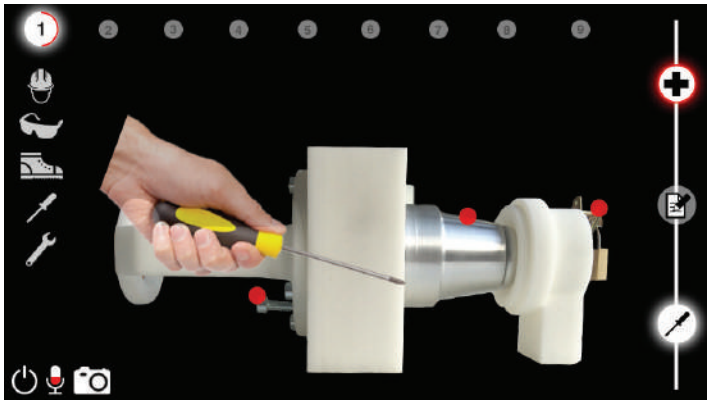


6. The design above shows how the right hand side menu could be changed to a circle system which was evident in some idea development.

MOCKUPS







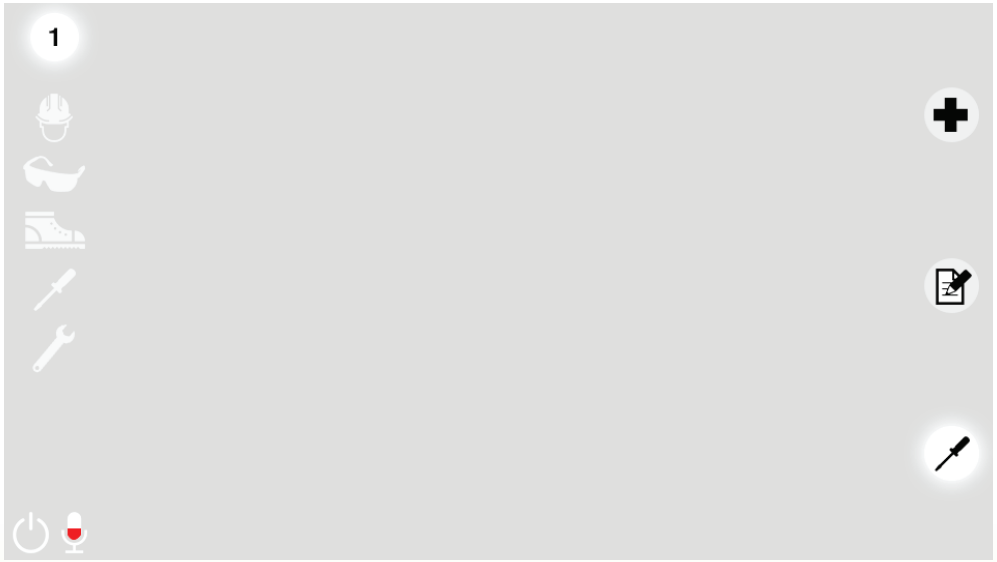
These are the first mockups that we created for the 2016 interface using Epson Smart glasses. After discussing we decided to use the circle menu bar on the right hand side because this was a more modern sleek design.

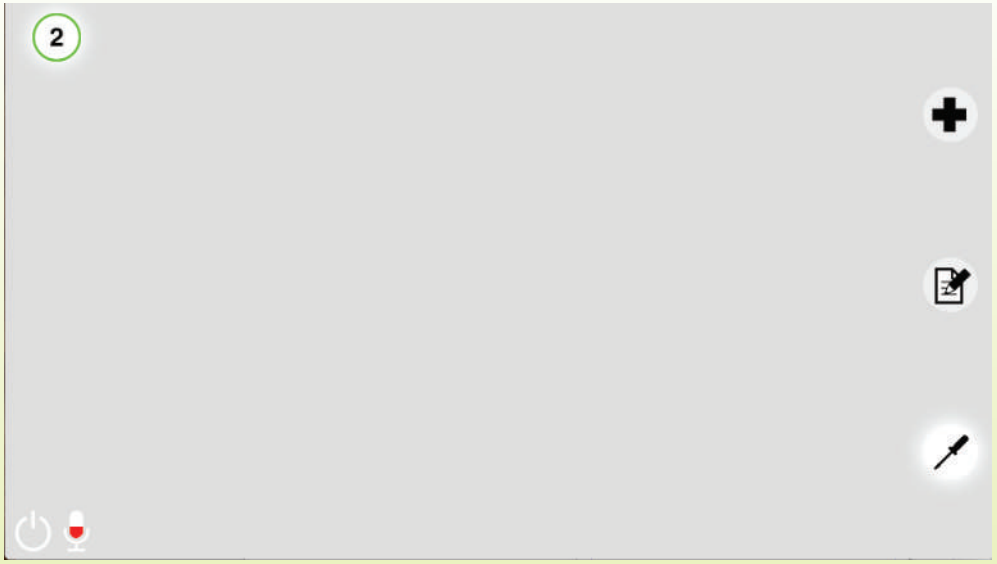
The progress bar and how the steps are displayed has been changed as well showing a circle and indicating what step the worker is currently on. The progress is then indicated around the circle changing from red to green.

After creating all of the screens for the prototype as mockups, we then began to continue to develop these mockups further until we had some final designs. The intertace began to evolve, as we took on board feeback from review 1 and 2 and continually improved the design of the interface.

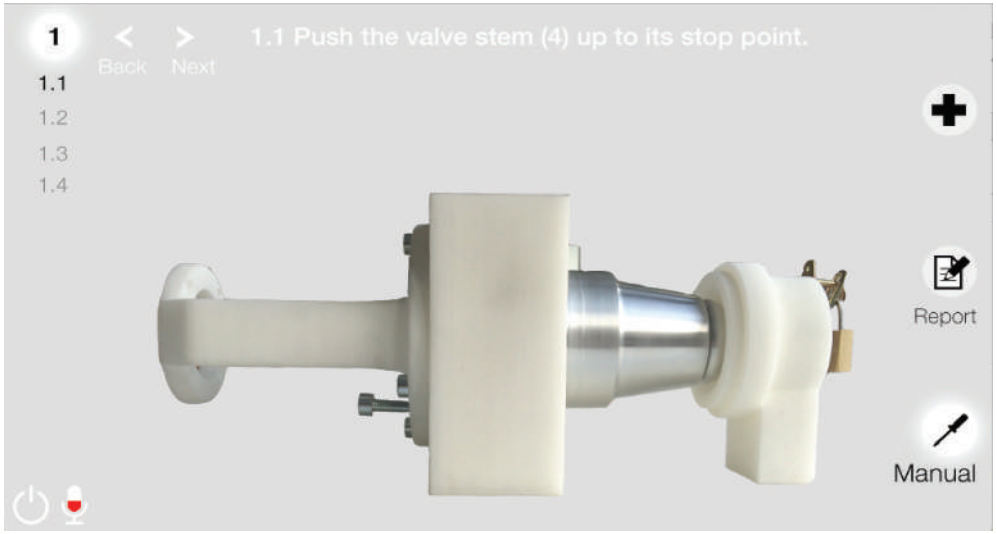
As you can see on the following two pages, the interface improved as we focused our efforts on the usability and functionality of the design. We also user tested the screens each time they were improved, looking for ways to make the interface more simple yet more effective.

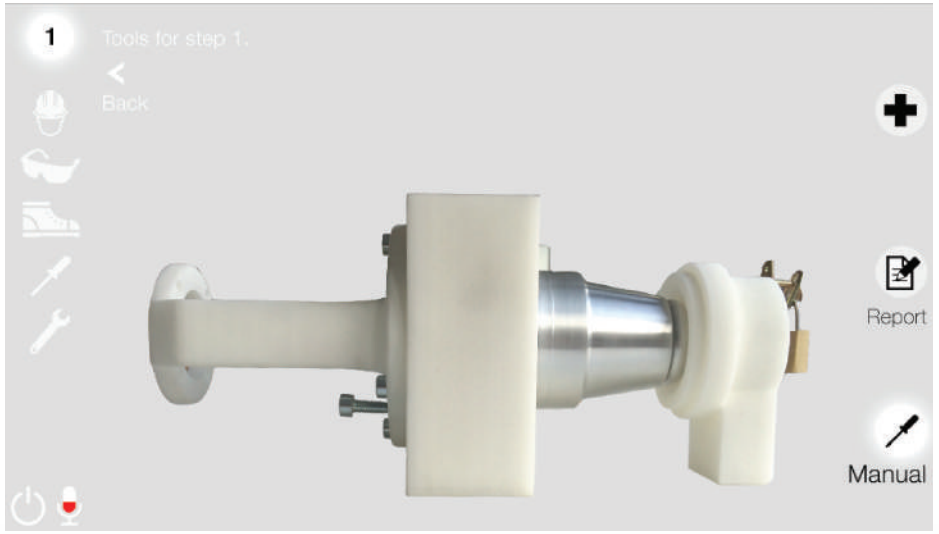
INTERFACE DEVELOPMENT

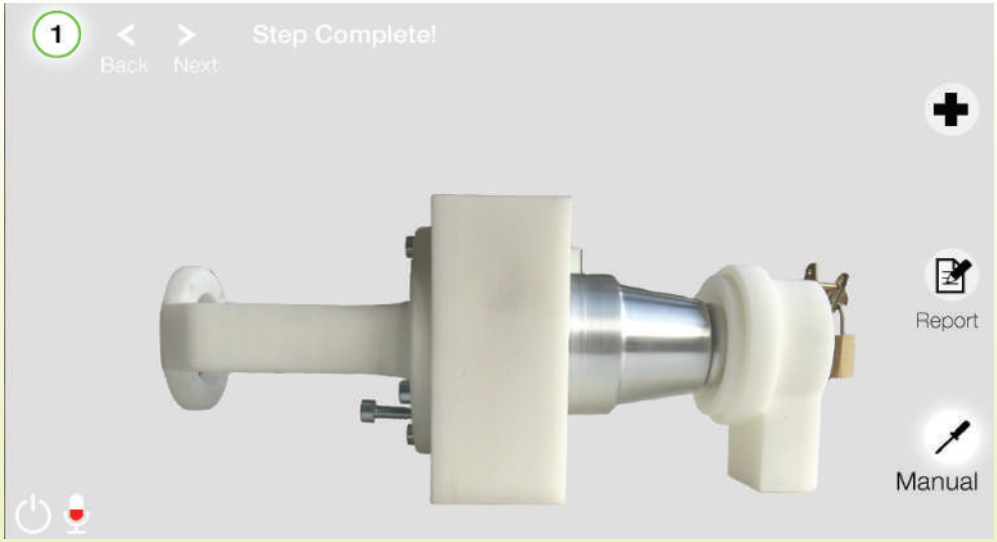


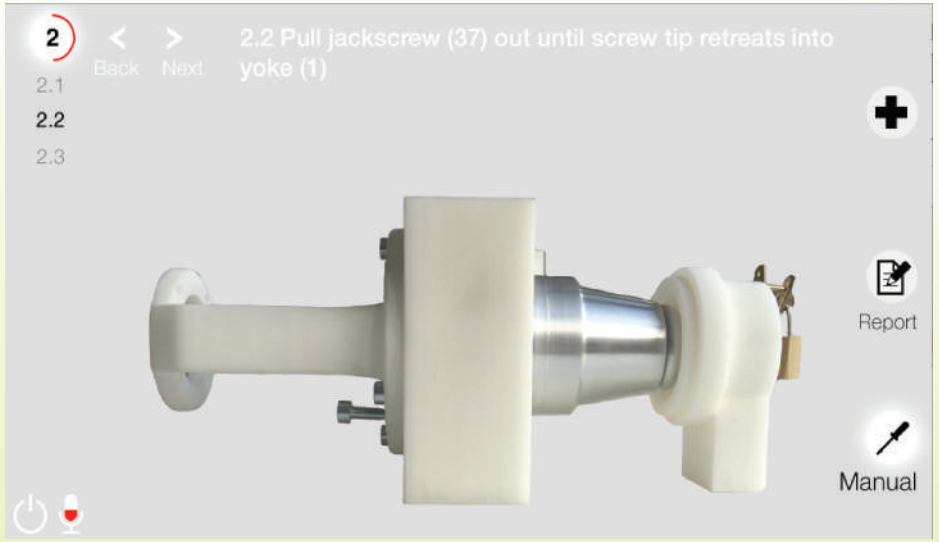


INTERFACE DEVELOPMENT









USER TESTING

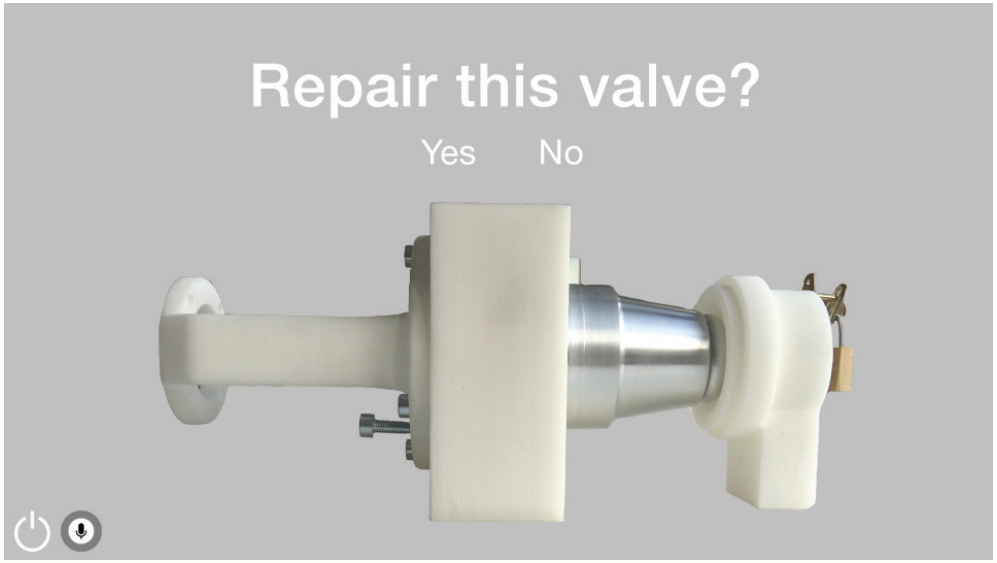
Throughout the task of creating the interface we have been able to use the Epson glasses to upload and test the screens.

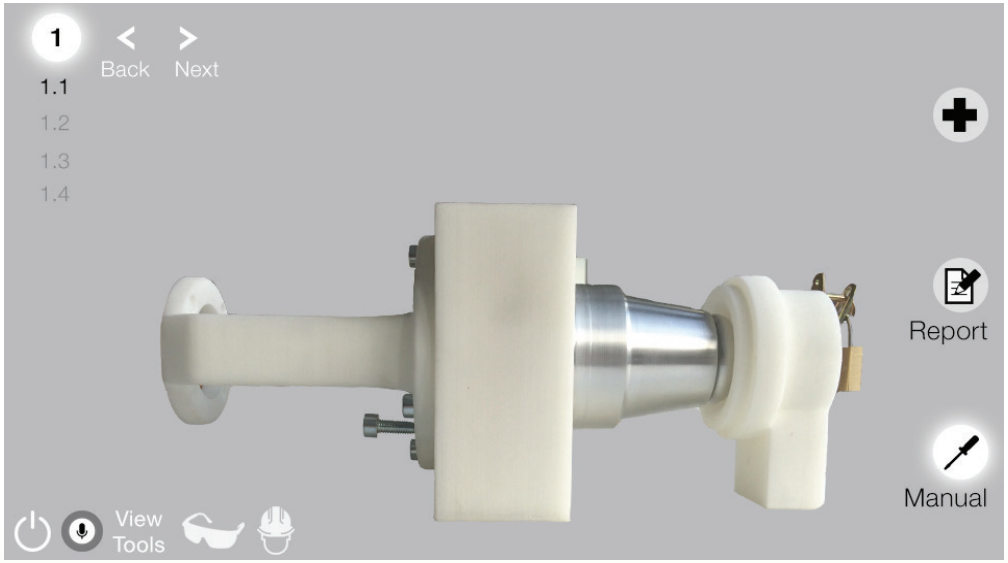
We accomplished this by creating PNGs within Photoshop that had blank backgrounds and connecting via Bluetooth transferring the image to the glasses.

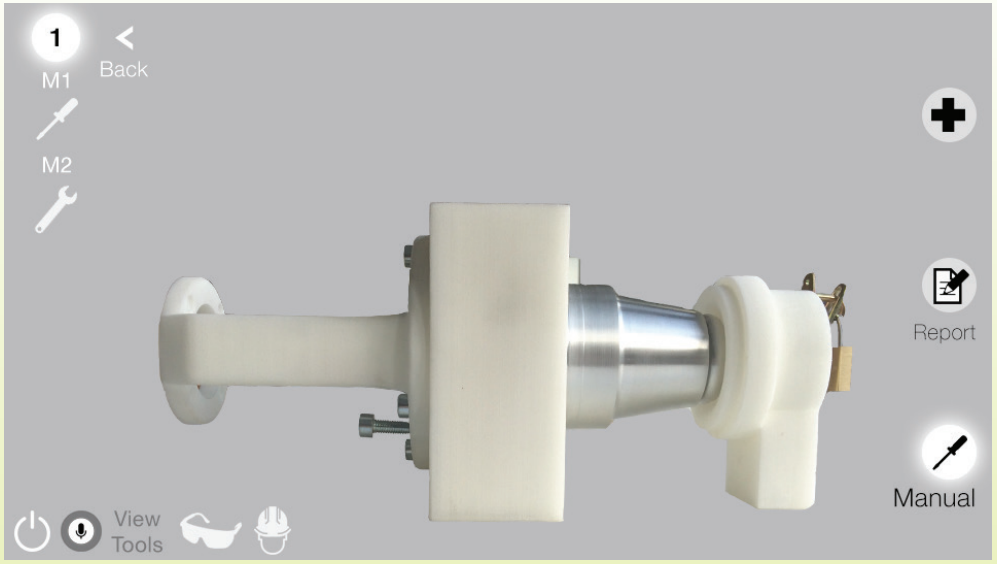
What we found when putting some of our final images on the glasses is that the interface works well against a lot of surfaces and is clear to see and read.

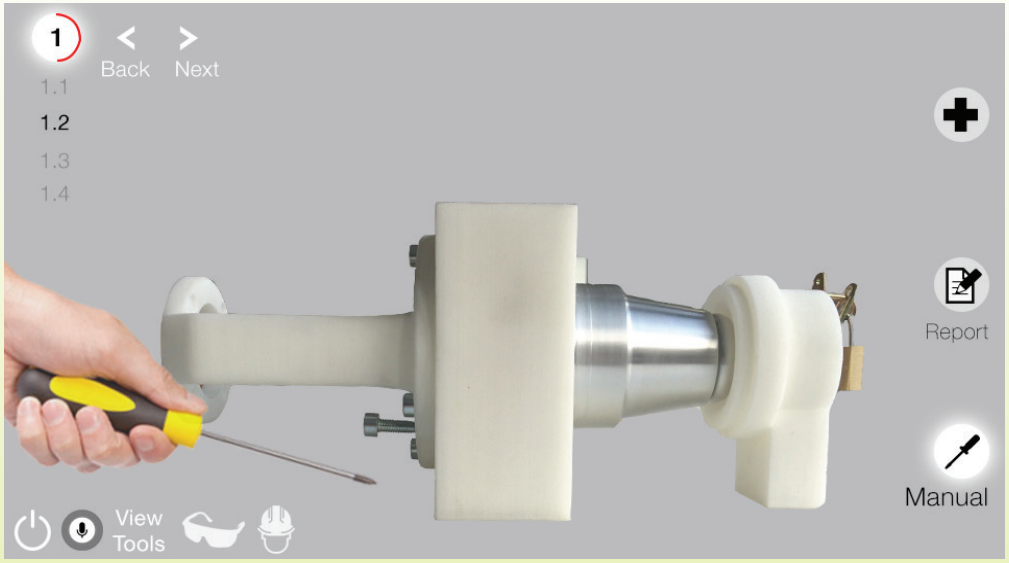
Also while navigation was hard at the time with only the tracking pad attached to the glasses, the voice recognition which we are going to implement would make navigation easier.

FINAL DESIGNS

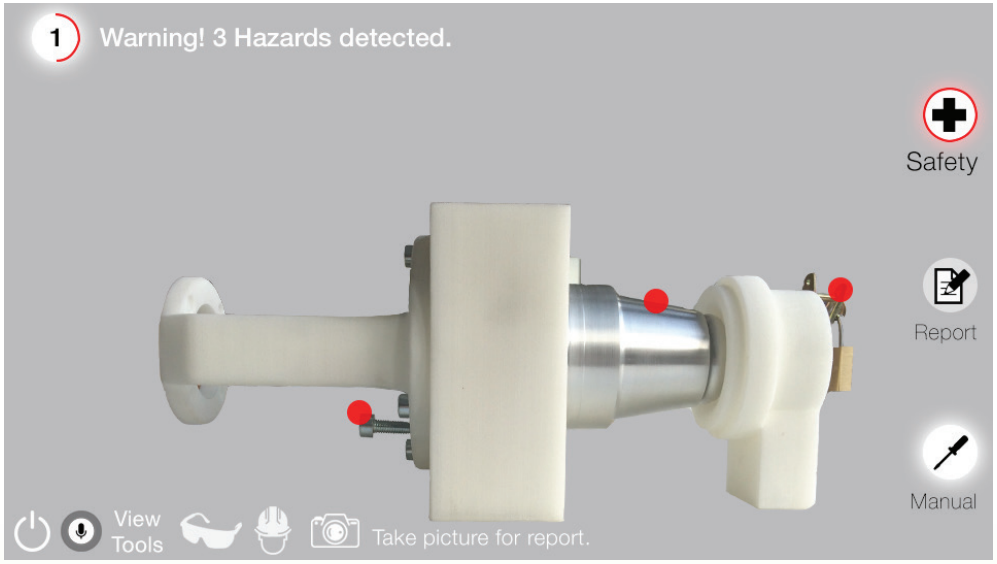


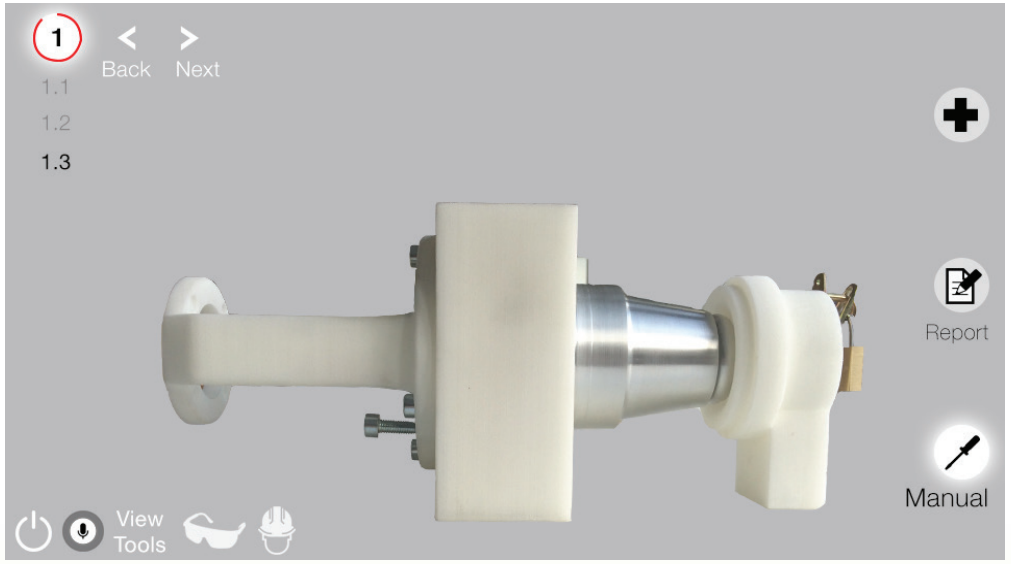


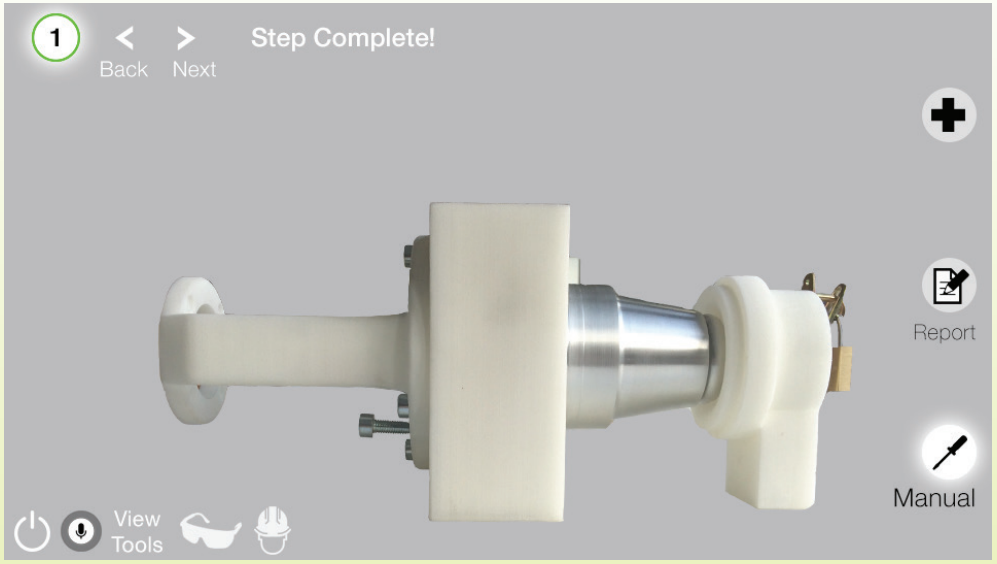


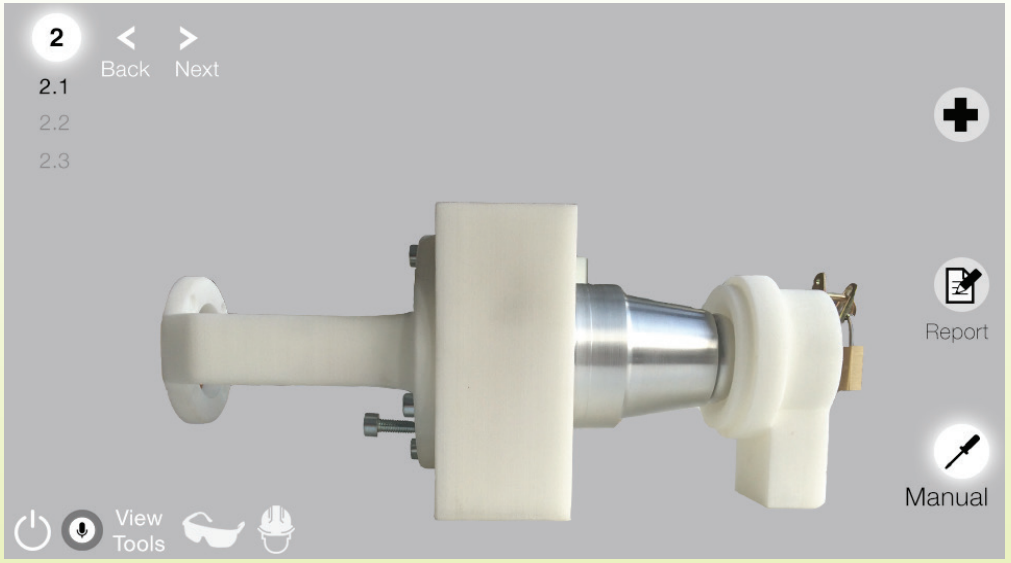


FINAL DESIGNS

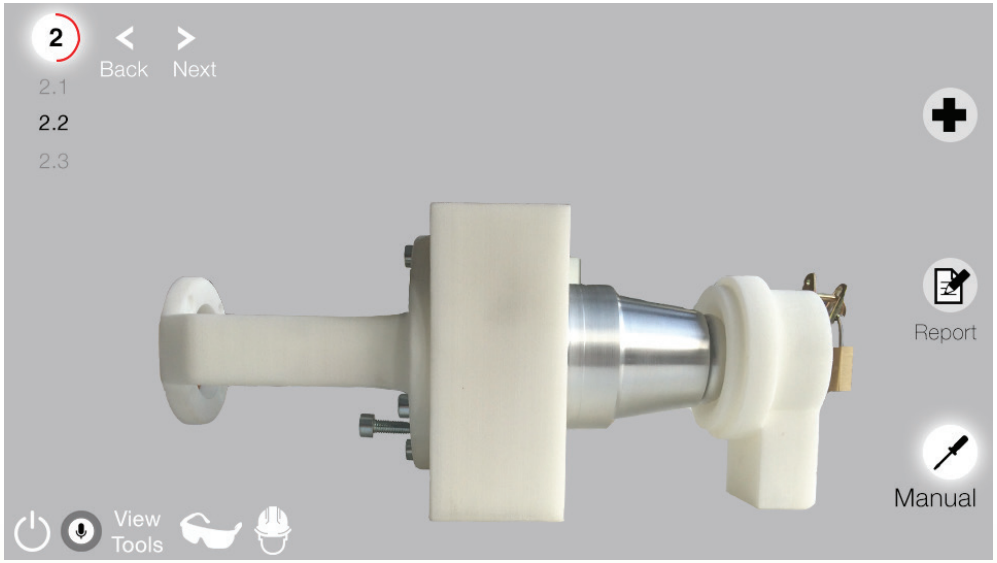


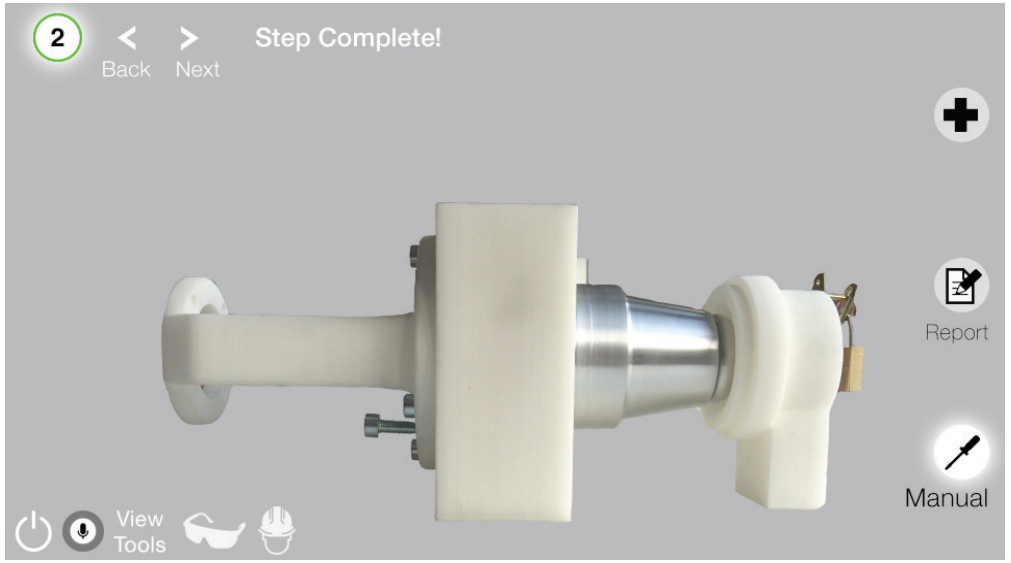


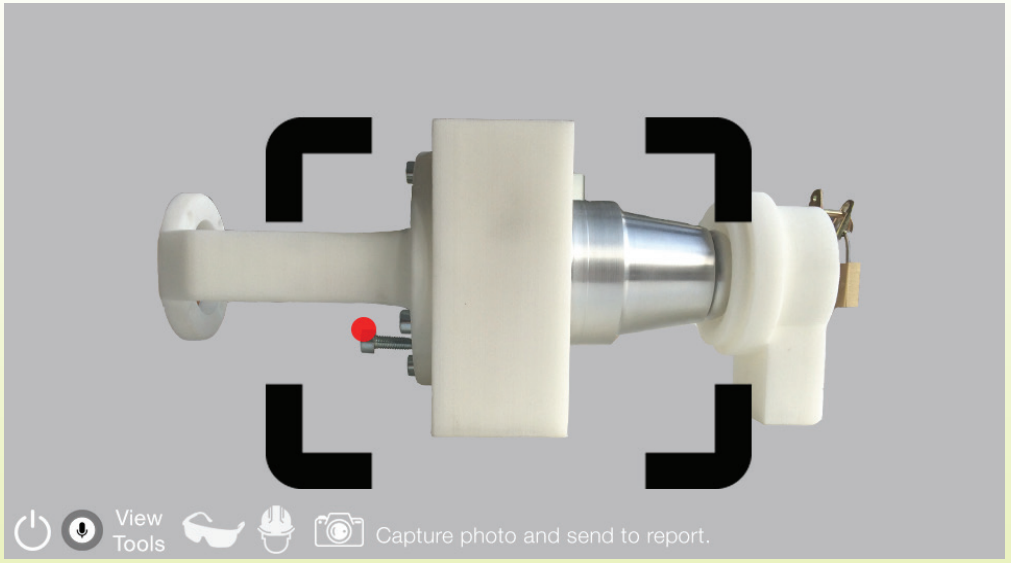




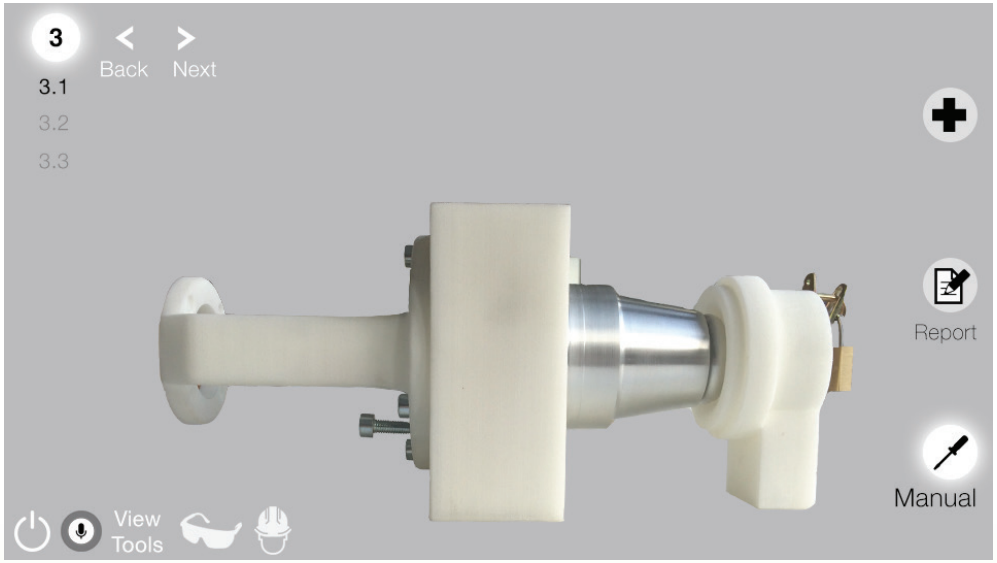
FINAL DESIGNS

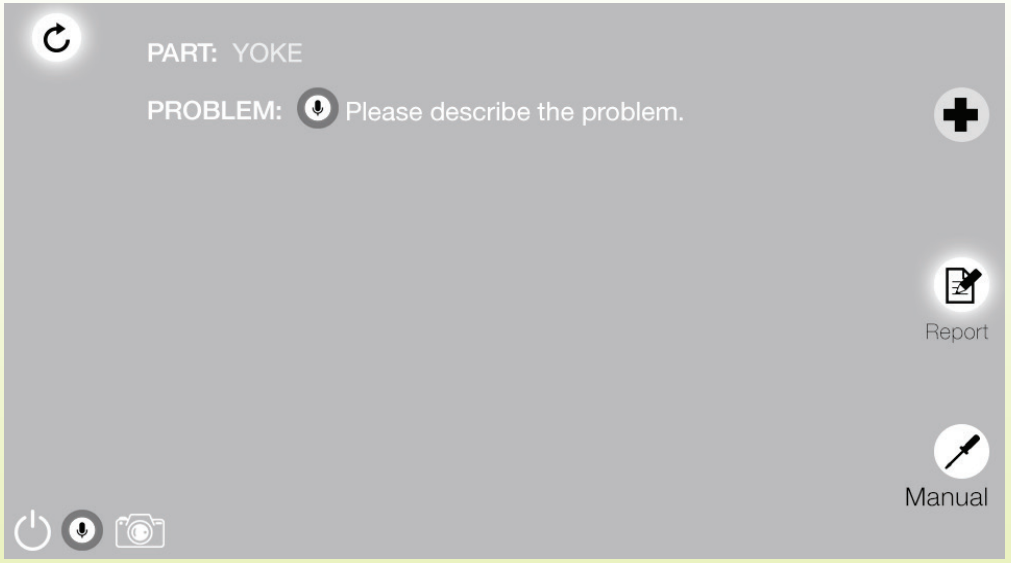




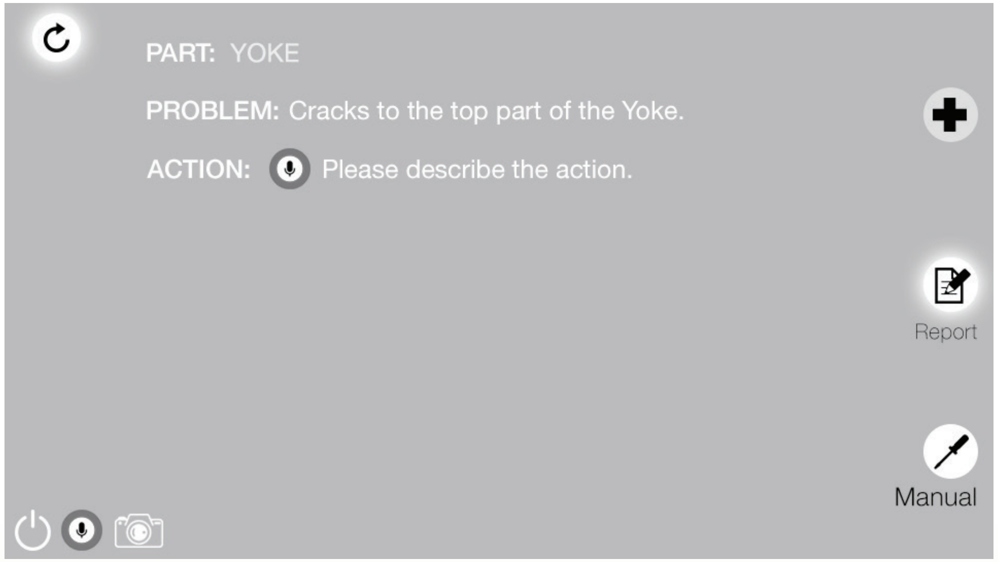


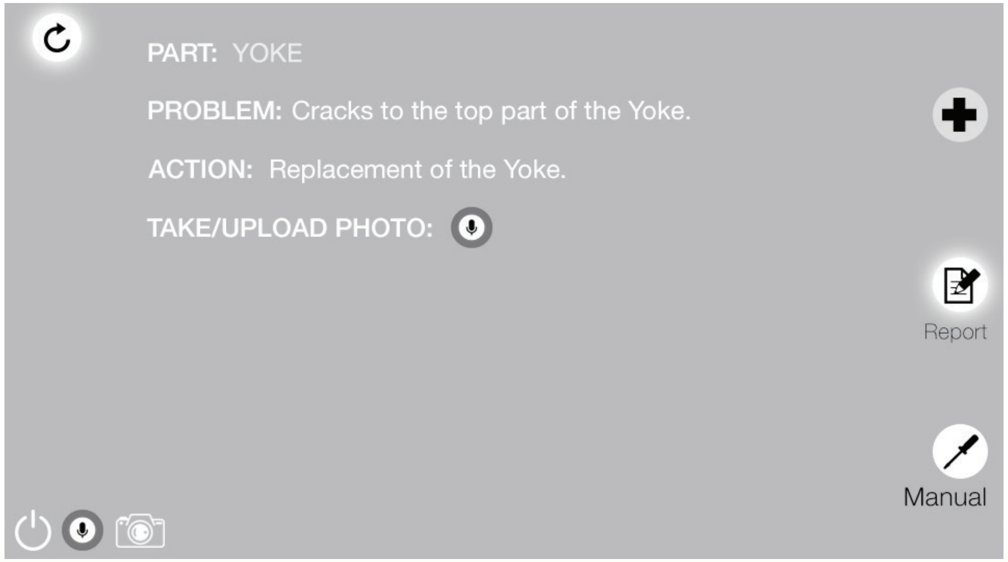
FINAL DESIGNS

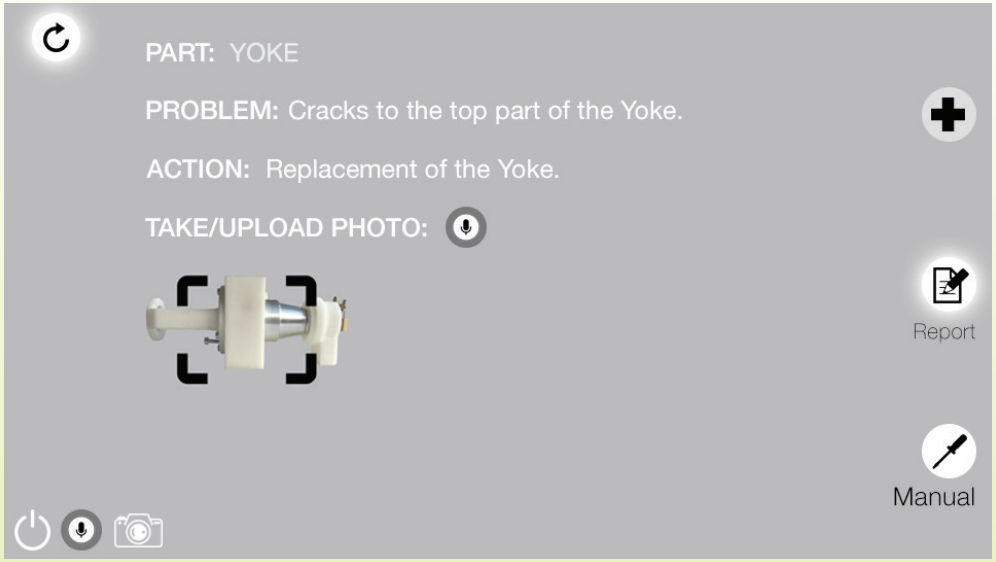


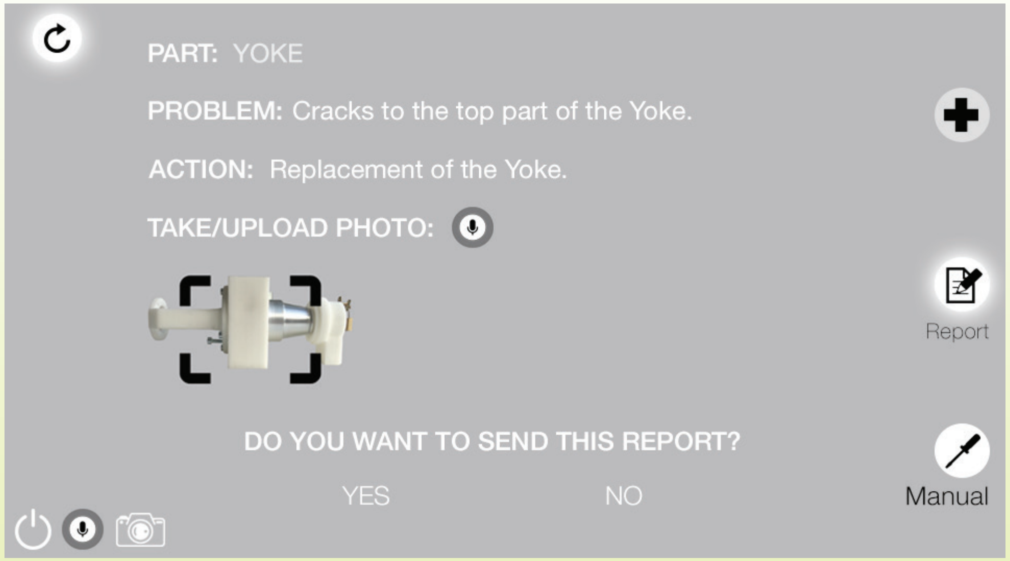


FINAL DESIGNS









FINAL DESIGNS

The final designs that we have created all use the same basic wireframe but the screen changes depending on what section you are on. The 7 states that the interface can be in are home screen, on/off, manual, report, health and safety, camera and speech recognition. The first state is for the home screen the style that you see is of the main menu bar on the right hand side and in the bottom left corner symbols indicating speech recognition, camera and on/off. This state is what workers first see when loading the screen.

The second state for the screen is on/off this is a very simple way of turning off the whole screen to have an unimpaired vision through the glasses. The third state the glasses have is the manual this is a large state with step-by-step instructions the workers follow the design to show these steps. A circle in the top left corner with the written step number indicates the step that the worker is on. The progress bar is then an outline around the circle this goes from red to green as it fills in with colour. Each step is also broken down into smaller stages which are represented in a dropdown numerical order list.

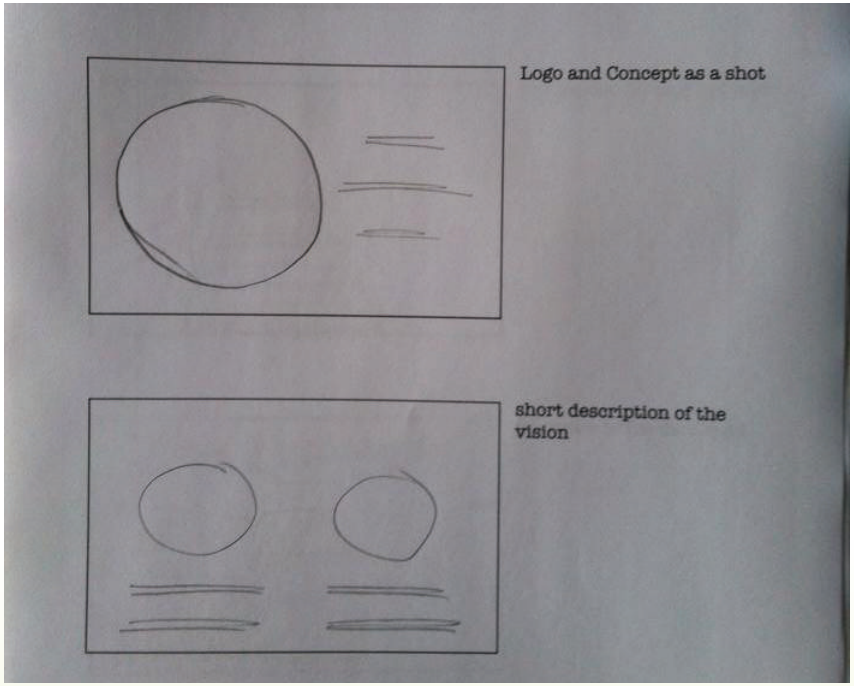
The reporting system like the manual appears in the top left corner. The reporting consists of text questions, which are quick and simple to answer for the worker. A fifth state is the health and safety this system reacts when there is a hazard and uses bright red to indicate problems wherever they are on the screen. The text version of the warning appears in the top left corner though.

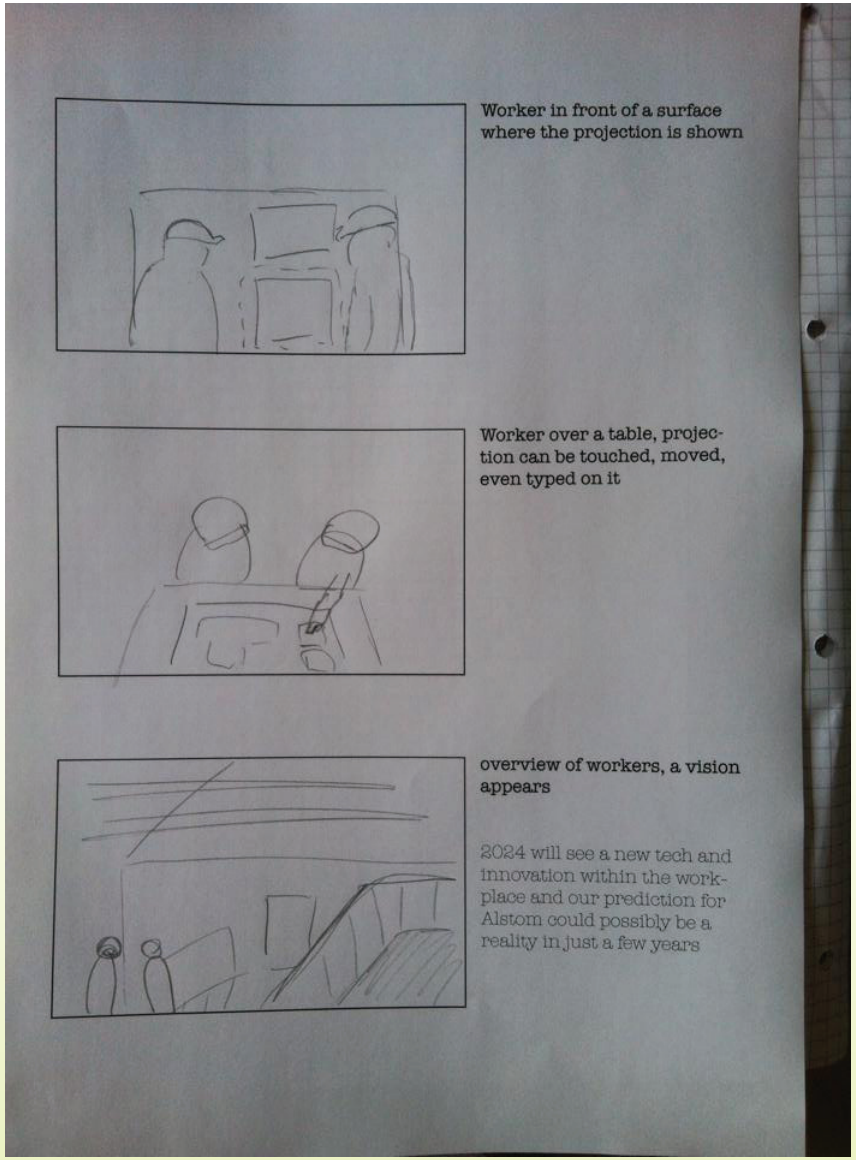
The camera is only indicated when it is within the reporting system. The camera symbol is in the bottom left corner and is highlighted when the camera is in use. The speech recognition is a state that is present through all of the states with the navigation being hands free and relying on the speech recognition for workers to use the interface. The final designs all use a sleek modern style, which uses a minimal menu bar and the use of symbols. Text as well is simple and easy to read make the design modern and concise.

The final designs have changed dramatically from the first initial mockups, leaving us with a functional, simple interface that has good usability and is effective.

6. 2024 DEVELOPMENT

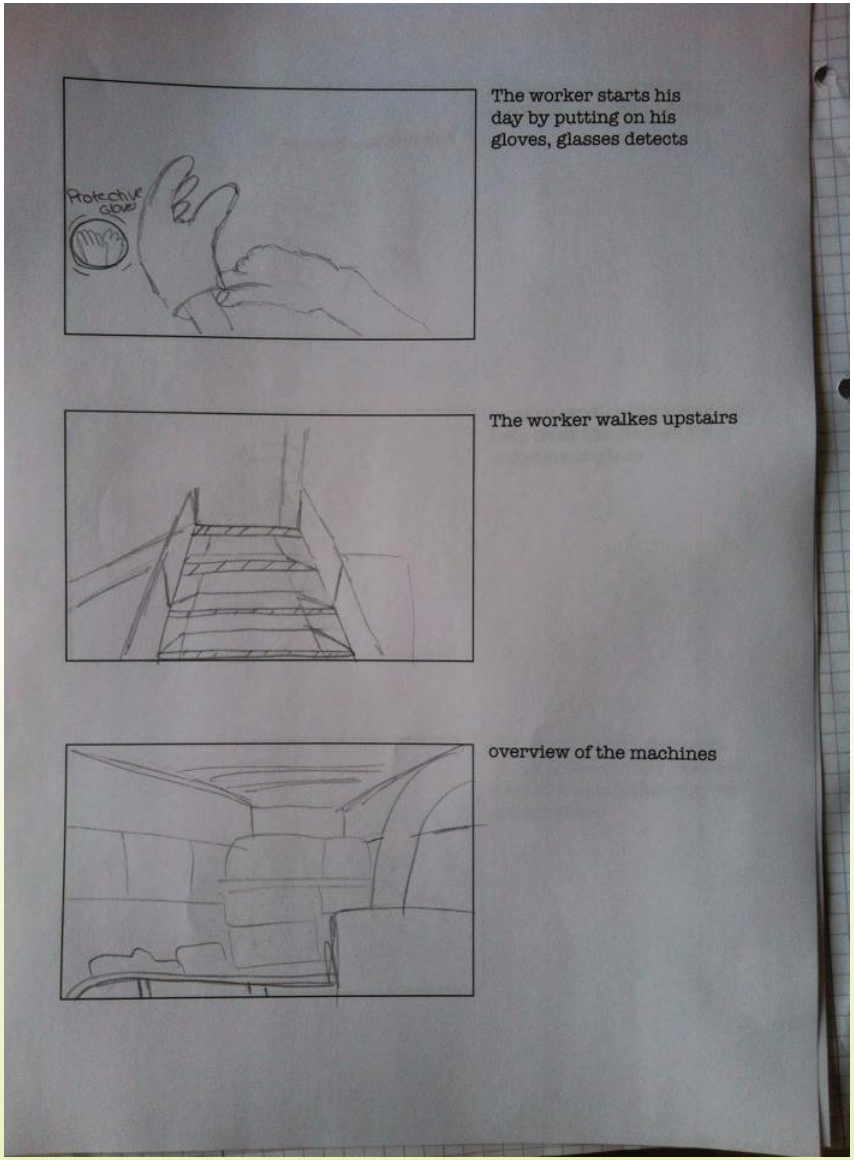
STORYBOARD

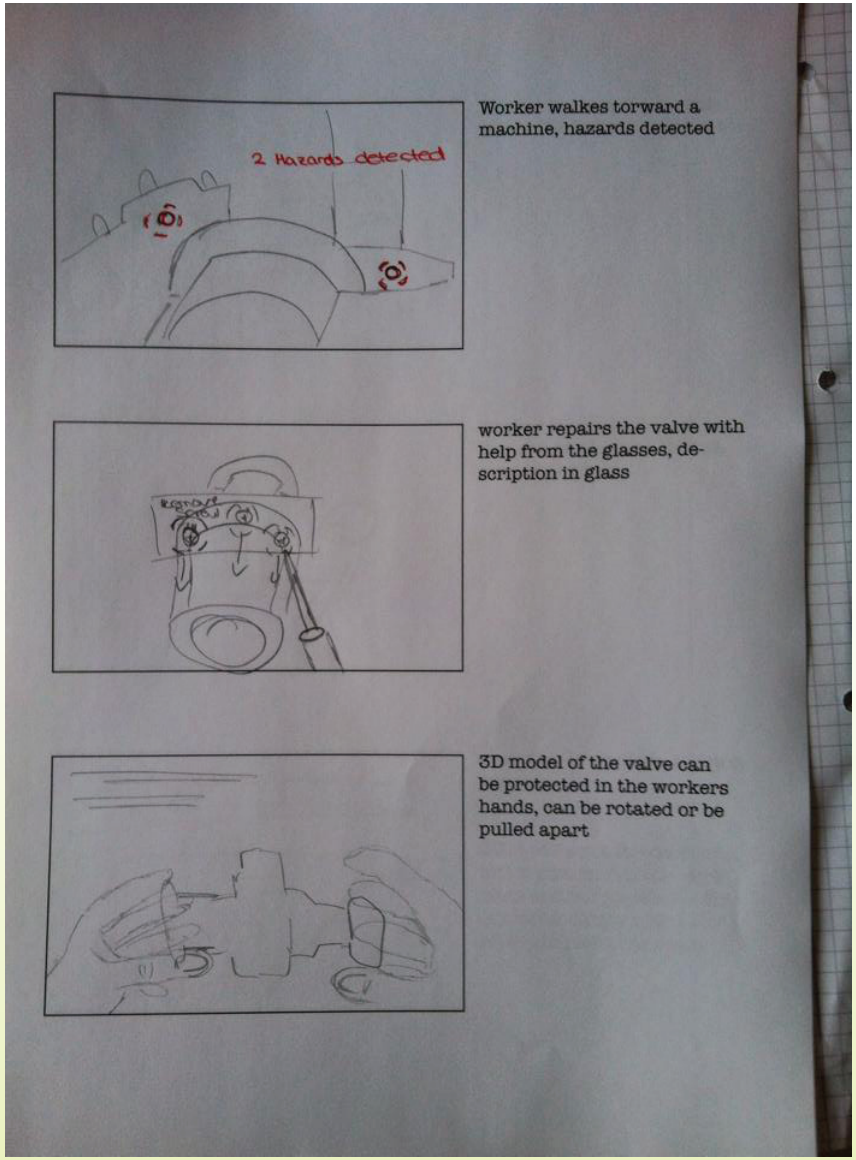




To develop a storyboard we first discussed in the group about our vision and the features of 2024. We decided not to replace all human workers with robots. We think it's important for the people and especially the unemployment rate that in 2024 still mainly the people work on and with the machines.
So we developed an idea that supports the humans work with robotic help.
Then Julia made a few sketches to show how our feature-ideas could look like and in the next step we discussed these ideas. After we decided how it should look like, we asked for the permission to film a few scenes at Alstom. We were allowed to do this so we knew we could add a few scenes of the work at Alstom. These were filmed by Fabian K. and Matthias at Alstom. The rest of the storyboard has been implemented by Fabian G. and Julia in the Merz Akademie in Germany with the valve model.

STORYBOARD


Protective glove
The worker starts his day by putting on his gloves, glasses detects
The worker walkes upstairs
overview of the machines


2 Hazards detected
Worker walkes torward a machine, hazards detected
worker repairs the valve with help from the glasses, description in glass
3D model of the valve can be protected in the workers hands, can be rotated or be pulled apart

FILMING

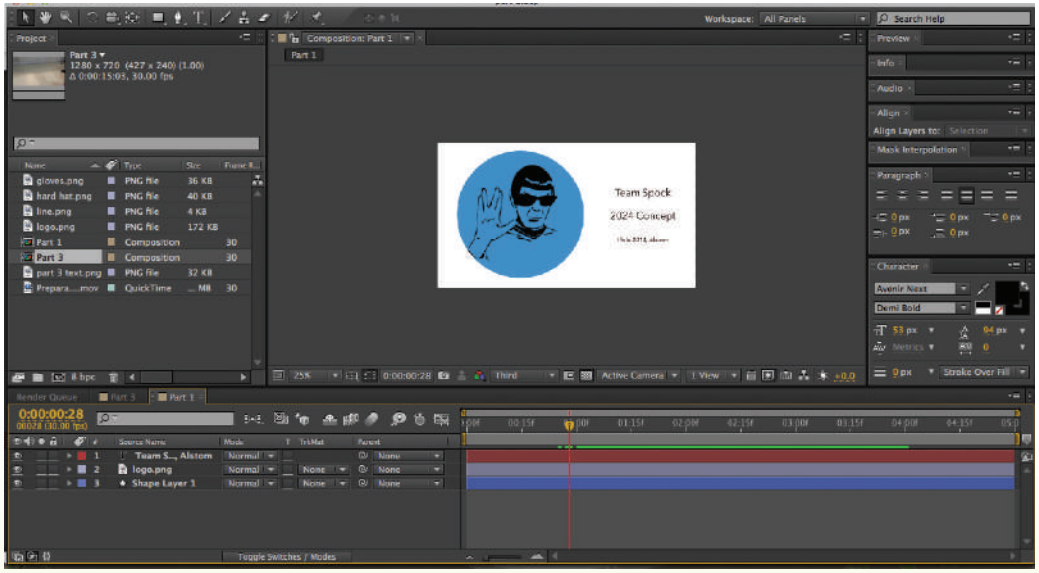
After the storyboard was ready we began with the filming, the goal was to have a short film, that gives a view into the possibilities of new technologies for 2024. A clean, simple lighting style, that looks modern was the aims for the video.

In order to make the movie more dynamic, we have worked with changes between the first-person-view and the third-person-view, with this, the viewer has the feeling of the in the moment sensation, and feels himself incorporated in the scene. Another effect that we used was to focus only on important parts on the sequence and to blur the other parts.

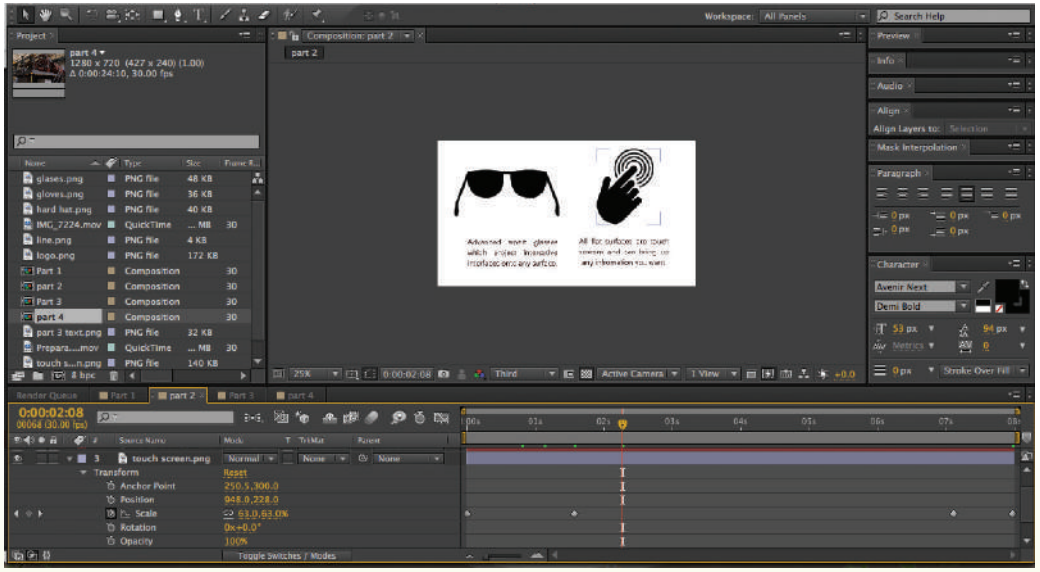
The technical equipment for the video that shows the vision for 2024 was a canon 60D and a manfrotto tripod. We used adobe premiere to cut the parts to a short, complete video. After the video parts was filmed, we added the user interfaces for the vision 2024 on the first-person-view parts in the video, using after effects.

VIDEO DEVELOPMENT

To create the final video for our 2024 concept Sophie used After Effects and the footage we had filmed to create the video. With After Effects she was able to create shapes and text to help explain our concept. The footage we used as well was a mix of the model of the valve and from inside Alstom training area in the factory in Birr.

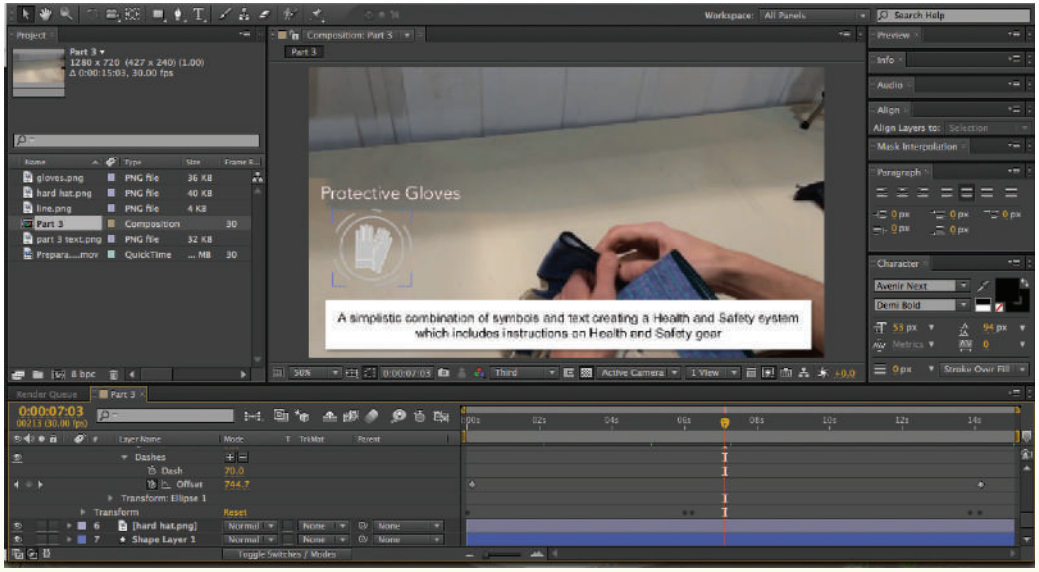


To create the video it was split into 11 parts including the title and credits. The screenshot below shows the first part in after effects this screen was a simple white background with our logo and title of the video. The white background is a simple white rectangle that stays put throughout. The logo and text though are at scale 0% at the start of the video and then go to 100% scale before going back down to 0. this creates good movement for the title within the video.

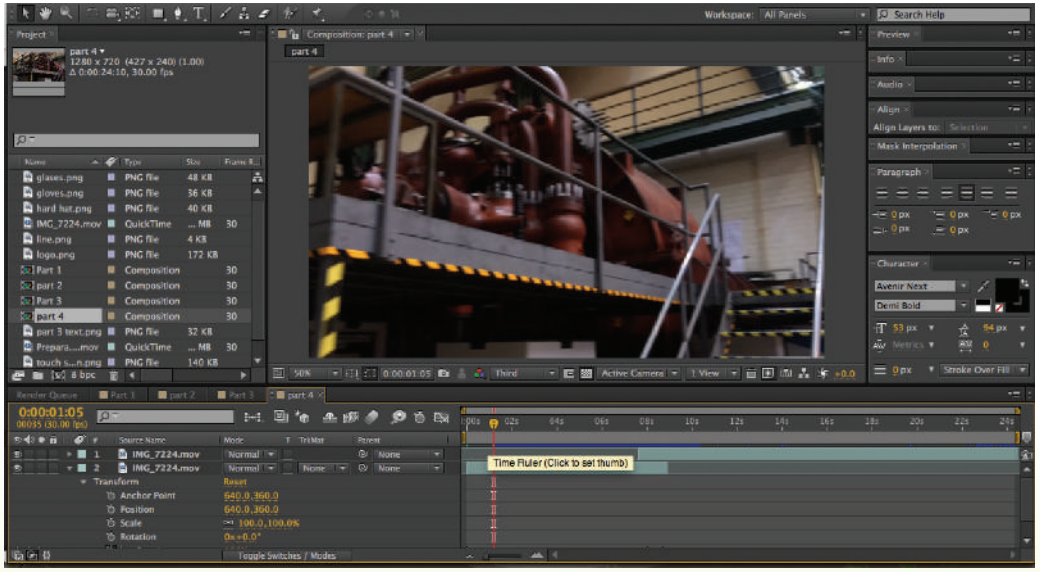


The screenshot below shows the first actual part of the video. For this part the use of a white background with images and text create a neat modern look. The way the screen is animated is the same as the title screen the white rectangle acting as the background stay put throughout and the images and text are then scaled between 0% and 100% to created a smooth transition. With the images disappearing at the end as well gave us a chance to have a smoother transition into the next video when the parts were all put together.

VIDEO DEVELOPMENT

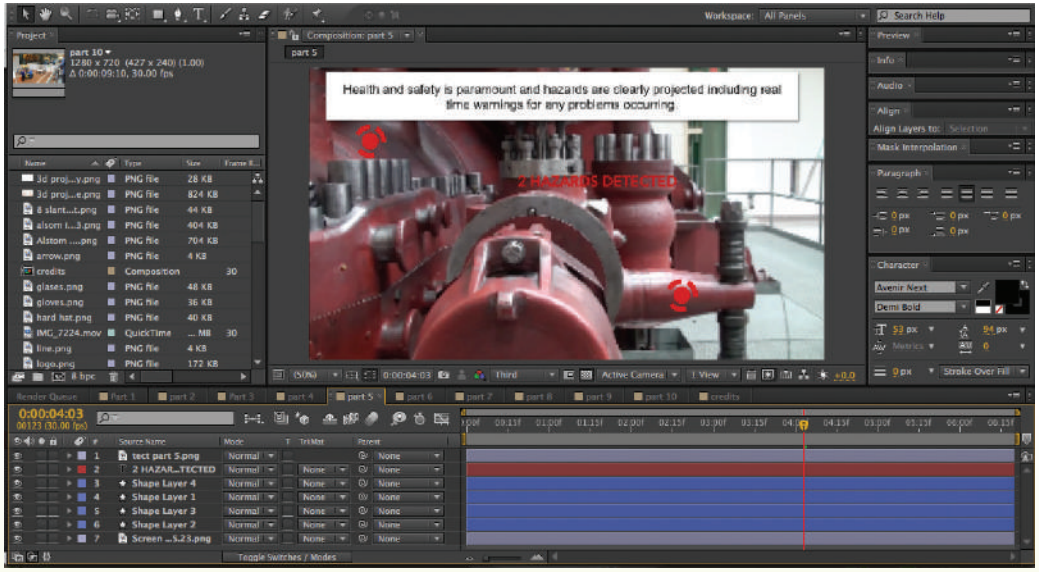


The use of video footage we have collected consists of the main bulk of the video. The part you can see in the screenshot below is for the health and safety gear instructions demonstrating the use of symbols which. This part consisted of many layers including the video footage, text, 2 images and 2 shape layers. The video footage acted as the main background and the original footage is cut down so that t is a shorter segment. The main text in the white box does not appear at the start of the video with its opacity at 0% but 5 seconds in the opacity is changed to 100% so that the text appears the text then fades out towards the end of the clip. The 2 image and shape layers come into the footage at different points but in the same way with the adjustment of the scale from 05 to 100%. The shape layers as well are edited by being made with dashes then by changing the offset this makes the circles spin.

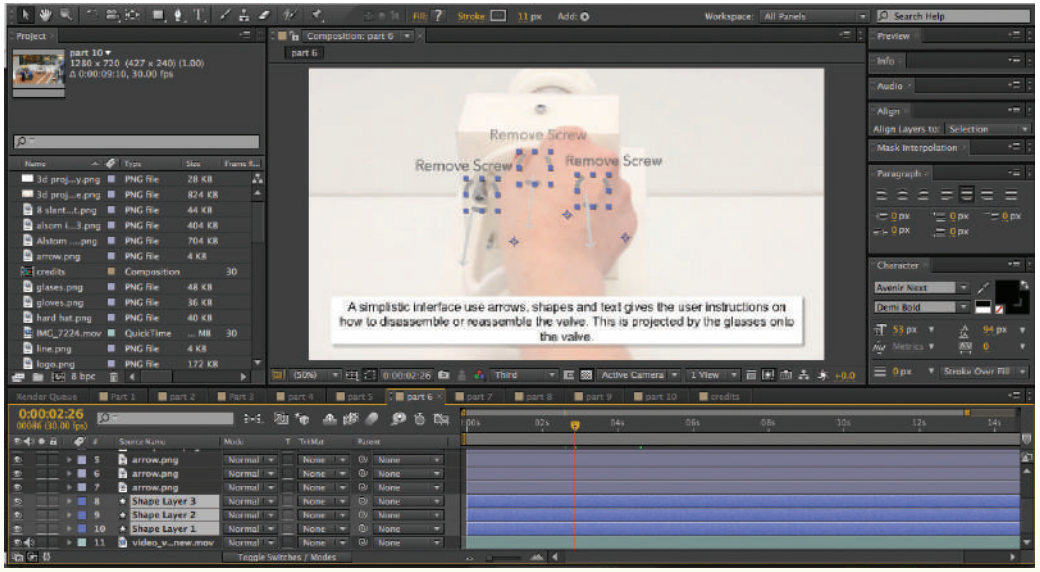


We were lucky enough to be able to gain access to the Alstom factory in Birr. Within the training area we were then able to gather footage that would help with creating the 2024 final video. Fabian and Matthias were the two groups members who did the filming. This part of the video uses footage of a person walking to the machine. The original footage was longer but has now been cut down and split to create a better and shorter sequence. The two parts the video is now in transition by changing the opacity of one video to 0% while making the other videos capacity go to 100%.

VIDEO DEVELOPMENT

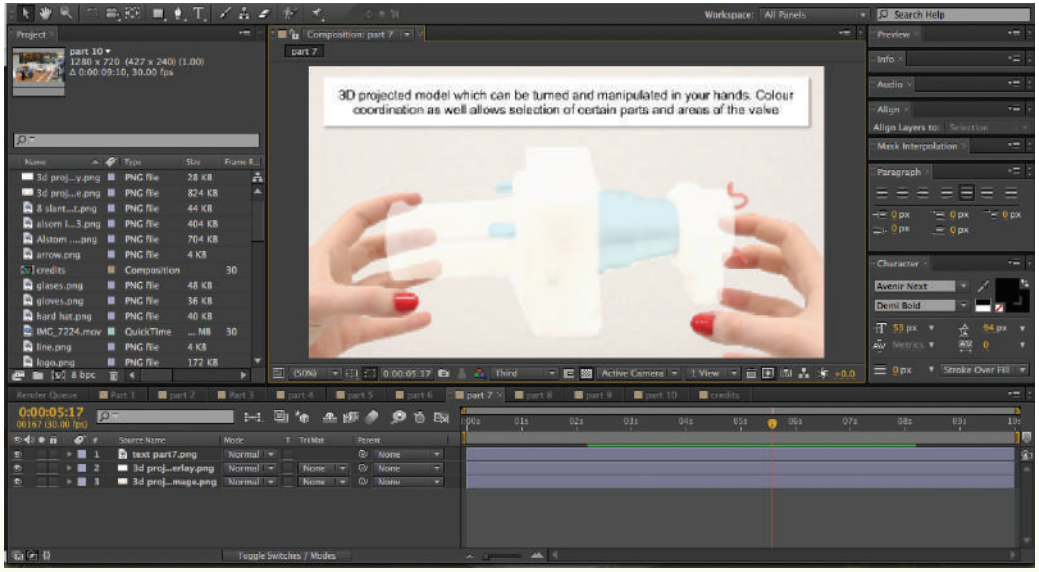


With the use of a tripod as well still footage was collected of the valve. Using this style footage an example of a hazard warning system is created with text to explain the concept. The layer for this part include the video footage as a main background, 4 shape layers, red text layer and text layer. The shape layers consist of two circles with are red and then 2 outline circles the offset of the outlines are done the same way as another part of the video making them spin, they enter the screen as well by scaling up and then exit by scaling down. The red text has the same transition as the shape layer. The final text fades into the video at the beginning and then fades out towards the end this is done by changing the opacity bewteen 0% and 100%

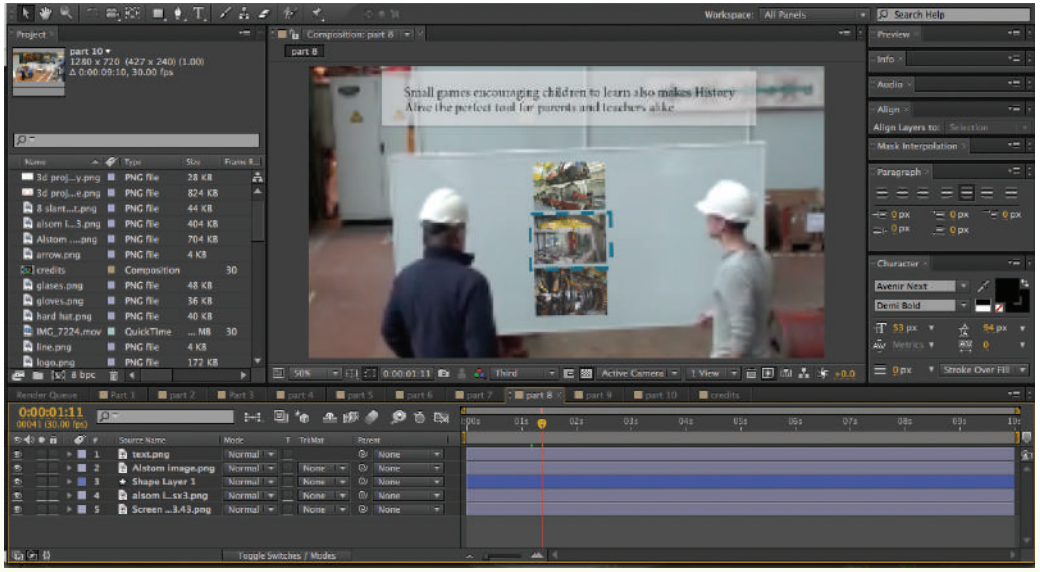


This section of the video is the most complicated with multiple use of layers, effects and transitions. The layer consist of the video footage, 3 shape layers that are circles, 3 image layers that are arrows and text. The video footage like before acts as the main background layer. The shape layers then consists of circles these circles include dashes, the offset is then edited to make the circles spin. The arrows are next to one circle each the effect that is created is that they are going back and forth. The movement of the arrows is a achieved by changing there position and entering a keyframe. The arrows, circles and grey text then transition into the clip by scaling up and then scaling down. The text in the white background then transition in like before with the changing of the opacity.

VIDEO DEVELOPMENT

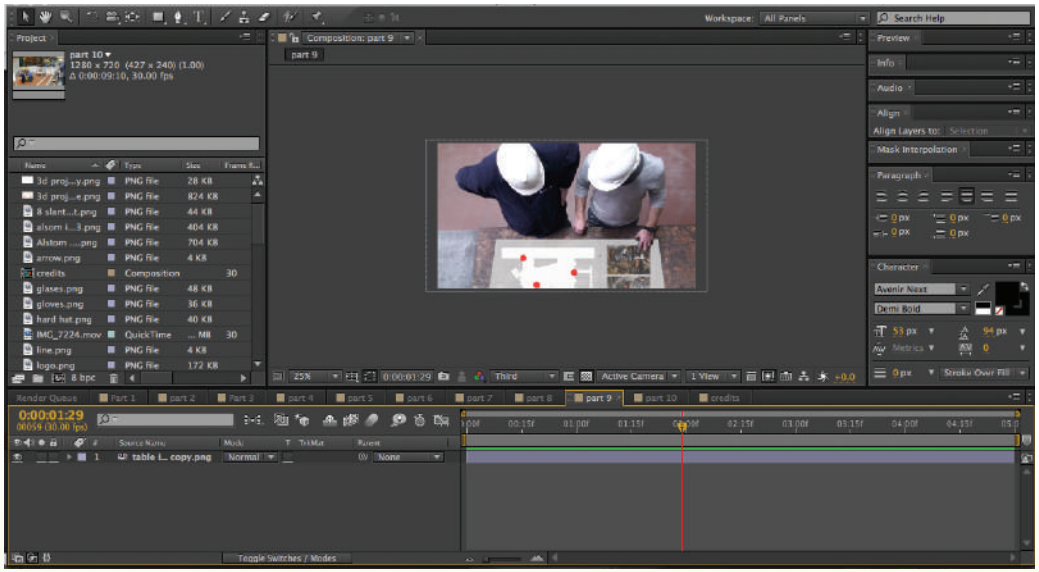


While we did film quite a lot by taking screenshots of videos we were able to create images in Photoshop to represent more complicated concepts. The screenshot below shows an image background layer with text overlaid on the top. The image was created in Photoshop and shows our concept of the 3D holographic models which you can interact with using your hands. The text layer is then overlaid in very much the same way as before with the change of opacity enabling it to fade in and out.

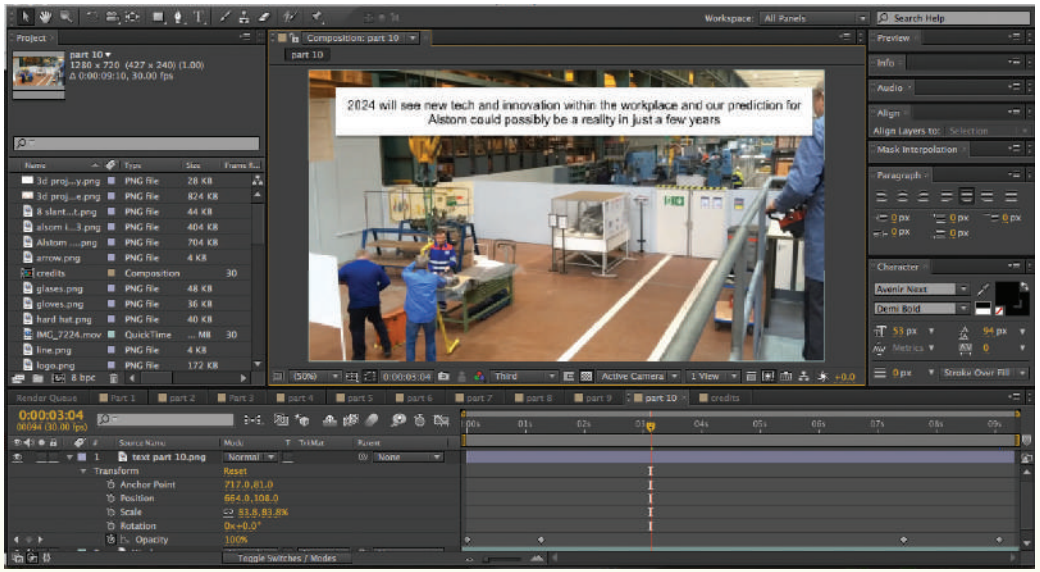


To prototype the touch screen interfaces which we predicted for 2024 we filmed upon plain backgrounds of boards and tables. Unfortunately when coming to edit the video the footage was too shaky to overlay anything so to create the interface we created an image from the vide. This image then acted as the background and using image and shape layers transitions were created to make it look like the board is a moving interface.

VIDEO DEVELOPMENT

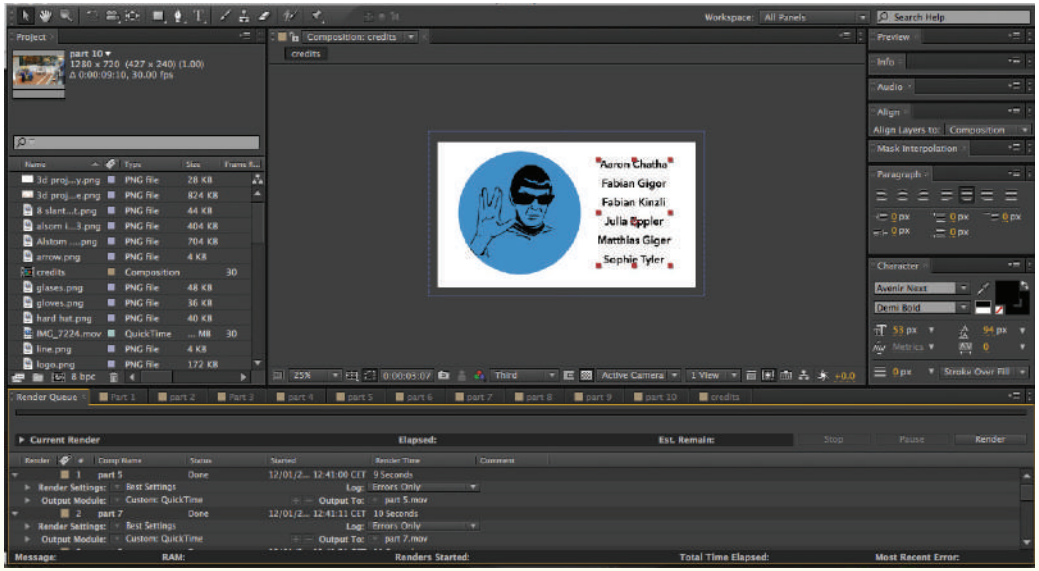


Like the board the table interface was the same so with the image in Photoshop we created an interface screen on the table this image acted as a background and was the easiest part of the video with no transition or effect overlaid. The image was created in Photoshop though by duplicating the image into two layers, then on one layer using the eraser the table and background are cut out leaving just the people. On the layer below the table is still there allowing shape layers to be added to create the interface. The people shape layer on top is then added again on top so that the hand looks like its on the interface.

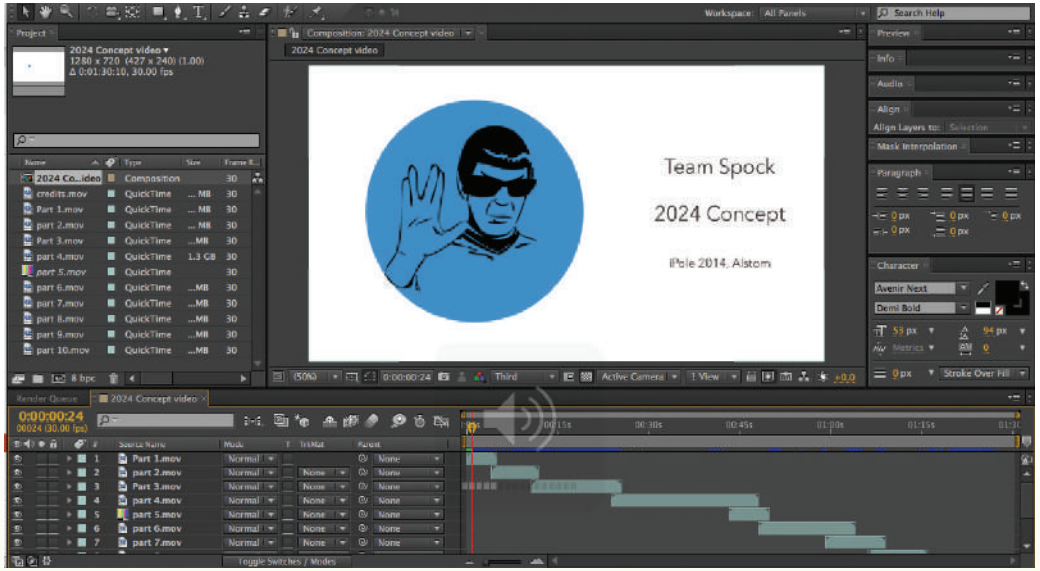


The final footage used on the video shows workers using the crane. This footage is the main background and then text is overlaid on the top. The text then has an effect added which allows it to fade in and out this is done by changing the opacity from 0% to 100% and then back again.

VIDEO DEVELOPMENT



The final screen for the video shows the credits. The credits include three layers of a white background, team logo image layer and text layer. The white background layer is a rectangle with stays still throughout. The image and text layer then copy the title in using scaling in transitions to scale up creating a smooth modern finish to the video.



After creating all the parts of the video by creating a new project we were then able to create a new project in after effect in this project all the parts became a layer each. With each layer they had to be positioned correctly and then some had opacity transitions added to make it smoother between videos. Once all the parts were in position as well the video came to the length of 1 minute 30 seconds exactly. With the video complete the last part was to insert a music file which we found. To edit the music the decibel setting was edited from 0% - 4% to play the music at a comfortable level.

7. CONCLUSION

PROJECT RESULTS

We believe, our vision consists two very important aspects to consider before using glasses at ALSTOM: There is the hands-free work which might be possible for the first time in user manual history. During the project, we had the possibility to learn more about the glasses and their interfaces.

Our results show that there are ways to present information in the right way on glasses but still,it's very important to develop new innovative user interfaces for glasses. Glasses are not like a web browser and not like a ticket machine. Information has to be shown very carefully and it should not completely cover the worker's natural view. We developed UI patterns which can help to solve these issues, namely placing the icons at the borders of the UI, using an easy icon language and provide important information in the center of the view only for a limited time.

The second aspect of our vision is health and safety. Glasses used as a manual will be a very important tool, which needs a lot of attention. Since it's on your head and the information is shown in front of your eyes, there are complications with your natural way of behaviour. For example it can happen that you don't focus on real things around you because you currently read something shown by the glasses. If you are walking around in an area with many hazards it can be dangerous and can even cause fatal injuries. Even during the safe areas at FHNW we sometimes had difficulties to find our way in classrooms, since we couldn't always see what's in front of us.

Designers and engineers should work hard in the next years to develop user interfaces which provide workers with the right information at the right time while still let them work in a safe way.

TEAM REFLECTION

For all of us it was the first project done in an international team. The kick-off days were great to get to know each other and exchange ideas about working together. We took the chance and already defined roles and project processes. Unfortunately, Julia couldn't attend the kick-off days but even this fact was no problem for us.
On sunday evening, Sophie and Aaron from England and Fabian from Germany could leave Switzerland and we all had a common understanding of our project.

We decided on a weekly Skype meeting on Sunday evening, which gave us the opportunity to share ideas, present results or ask questions. Part of the Skype meeting was also a retrospective, which we tried to do every two weeks. The retrospective was the social part of our meeting, which gave us the possibility to complain about other's work or to talk about fears. We all agree on the fact that we always could communicate in a good way.

Nevertheless, one or two weeks after we had to take the first decisions, the first misunderstandings came up. We realized that in an international project it needs more effort while presenting ideas, while listening to team members, while asking questions. It's easy to say that you understood other's ideas, because you are only connected by audio and video.
We all needed some time to realize these difficulties and we decided to go on slower and spend more time on explaining new ideas, to prevent further misunderstandings. Additionally, we started to work more visually and use tools, which enabled us to comment on user interface drafts. By this, we were able to establish a common sense of the project goal again.

To sum up, it was a great experience to work in an international team and get to know other people with other mindsets. It showed us, that it's possible to even finish big projects with people from different backgrounds. It just needs more attention, more emphasizing and more patience.

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